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ARTICULATED TOTAL BODY MODEL ENHANCEMENTS
Volume 2: User's Guide

LOUISE A. OBERGEFELL
HARRY G. ARMSTRONG AEROSPACE MEDICAL RESEARCH LABORATORY
BIODYNAMICS AND BIOENGINEERING DIVISION
MODELING AND ANALYSIS BRANCH

THOMAS R. GARDNER
SYSTEMS RESEARCH LABORATORIES, INC.
2800 INDIAN RIPPLE ROAD
DAYTON, OHIO 45440

INTS KALEPS
HARRY G. ARMSTRONG AEROSPACE MEDICAL RESEARCH LABORATORY
BIODYNAMICS AND BIOENGINEERING DIVISION
MODELING AND ANALYSIS BRANCH

JOHN T. FLECK
J & J TECHNOLOGIES, INC.
92 HENNING DRIVE
ORCHARD PARK, NEW YORK 14127

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HARRY G. ARMSTRONG AEROSPACE MEDICAL RESEARCH LABORATORY
HUMAN SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6573

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This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

Henning E. von Gierke

HENNING E. VON GIERKE, Dr Ing
Director
Biodynamics and Bioengineering Division
Armstrong Aerospace Medical Research Laboratory

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The Articulated Total Body (ATB) Model is used at the Harry G. Armstrong Aerospace Medical Research Laboratory (AAMRL) to study human body biomechanics in various dynamic environments, especially aircraft ejection with windblast exposure. In order to improve the model's predicted results and capabilities, a number of modifications have been made. These modifications include the capability to have segment contact ellipsoids block the wind from other segments, an option to prescribe velocity dependent wind forces, a correction to prevent angular drift in the joints, improved contact force calculations for segment contact near a plane's edge, the capability to specify as input multi-axis angular displacements to describe the vehicle motion, a slip joint capability and a hyperellipsoid option. Along with these major changes, a number of minor corrections and clarifications have been included to form the ATB-IV version. The results of these modifications have been documented in three volumes of which this is Volume 2, The User's Guide. It contains a new input description for ATB-IV, some example simulations and other information on

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22a. NAME OF RESPONSIBLE INDIVIDUAL: Louise A. Obergefell

22b. TELEPHONE *(Include Area Code)*: (513) 255-5963

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setting up the input and running the program. Volume 1 contains a description of the ATB-IV modifications and Volume 3 is an updated programmer's guide containing a listing of all the ATB-IV subroutines.

PREFACE

This report incorporates the work done in a number of different efforts to improve the Articulated Total Body (ATB) model's capability to simulate human body biomechanics in various dynamic environments, especially aircraft ejection with windblast exposure.

The majority of modifications to the model fall into six categories:

- wind force option
- joint drift correction
- edge effect option
- multi-axis angular displacement vehicle motion prescription
- slip joint option
- hyperellipsoid option

These improvements have been combined to form the ATB-IV version on the Armstrong Aerospace Medical Research Laboratory's (AAMRL) Concurrent computer system at Wright-Patterson Air Force Base. AAMRL, Systems Research Laboratories, Inc. and J&J Technologies Inc. and the National Highway Traffic Safety Administration have all contributed to the technical work described herein.

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1.0 INTRODUCTION

The Articulated Total Body (ATB) Model is used at the Armstrong Aerospace Medical Research Laboratory (AAMRL) for predicting gross human body response in various dynamic environments, especially aircraft ejection with windblast exposure. Aerodynamic force application and a harness belt capability were added to the Crash Victim Simulation (CVS) Program (Ref. 1), by Calspan Corporation in 1975 for AMRL (Ref. 2), and the resulting program became known as the ATB model. In 1980, Calspan made a number of modifications to the ATB model combining it with the then current 3-D Crash Victim Simulation program to form the ATB-II model (Ref. 3). Complete documentation of the program through the ATB-II version was performed by Calspan Corp. (Ref. 4). A new version, ATB-III, was generated which included the improvements made by J & J Technologies, Inc to model the body response to windblast for AMRL (Ref. 5).

A number of additional efforts have been made to improve various aspects of the ATB-III model, with emphasis on its capability to simulate aircraft ejection with windblast exposure as well as complex automobile accidents.

This volume, User's Guide, contains updated information for the ATB user and a new input description for ATB-IV. Much of this volume is a reprinting with modifications and updates of Volume 2 of Calspan's report on the Crash Victim Simulator (Ref 4).

Section 2 of this volume gives a general description of the ATB model and its structure. An overview of the ATB input data is in Section 3, while a complete input description for ATB-IV.0 is in Section 4. Section 5 lists the stops within the ATB model. A description of the logical units used by the model including the time history and RSTART options is in Section 6, and the appendices contain some example input and output from the model.

2.0 GENERAL FORMULATION OF THE ATB MODEL

The Articulated Total Body (ATB) Model is primarily designed to evaluate the three-dimensional dynamic response of a system of rigid bodies when subjected to a dynamic environment consisting of applied forces and interactive contact forces. Although the ATB Model was originally developed to model the dynamic response of crash dummies and, with later modifications, the response of the human, the ATB Model is quite general in nature and can be used to simulate a wide range of physical problems that can be approximated as a system of connected or free rigid bodies. The ATB Model has been used to model such widely diverse physical phenomena as human body dynamics, the motion of the balls in a billiards game and the transient response of an MX missle suspended from cables in a wind tunnel. This flexibility can cause the application of the ATB program to appear to be overly complex to the uninitiated user. The purpose of this discussion is to present some of those program features that should be mastered to utilize the ATB program. Throughout this discussion a number of input variables will be mentioned. A complete description of these and other input variables is presented in Section 4.

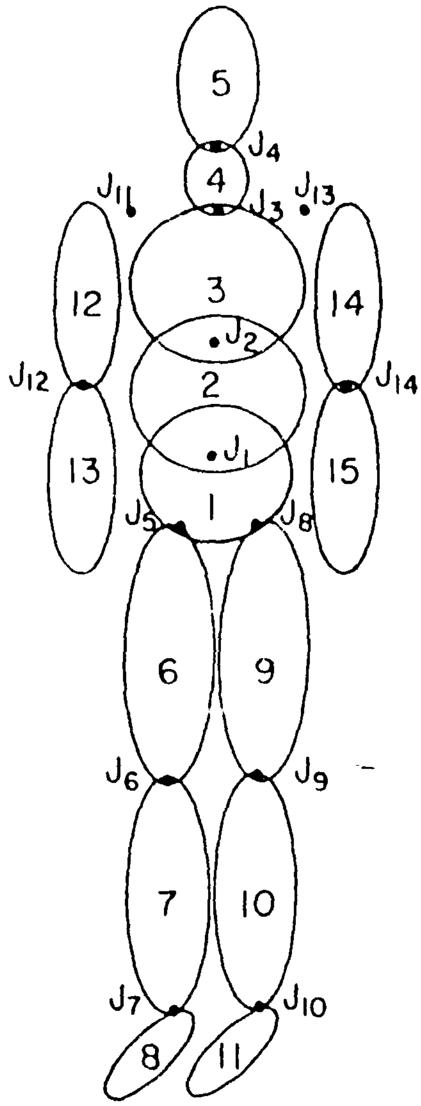
To avoid confusion between the overall body or object to be modeled and the individual rigid bodies that make up the overall body, throughout this report the term "segment" will henceforth be used to refer to the individual rigid bodies and the term "body" will refer to the overall body or object to be modeled. The approach used in the ATB Model to model the human or manikin body (the "body" in the ATB Model simulation) is to consider the body as being segmented into individual rigid bodies (the "segments" in the ATB Model) each having the mass of the body between body joints or, in the case of single-jointed segments, such as the foot, distal to the joint. An example would be the left upper arm segment, which represents the mass of the body between the shoulder joint and the elbow joint. Segments are assigned mass and moments-of-inertia and joined at locations representing the physical joints of the human body, such as the shoulder joint or the knee joint.

2.1 CHAIN STRUCTURE OF THE ATB MODEL

The system to be simulated by the ATB Model can be made up of one or more segments which may be connected or free. The system can be made up of a number of free segments, a number of segments coupled together at joints or a combination of both. A body made up of coupled segments should form an open chain or a tree structure. While this is not an absolute requirement, closed chains may encounter computational problems. One must also be careful not to exceed the maximum number of segments specified by the dimension statements of the program variables. Currently this maximum is 30.

All body models are composed of a Number of body SEGments, NSEG, (NSEG and similar terms refer to variable names in the ATB Model computer code and are defined in the ATB Input Description, presented in Section 4.0), and a Number of JoiNTs, NJNT, that are input parameters for a particular simulation. Figure 1 depicts the 15 segment model with 14 joints that is commonly used in car crash and aircraft ejection simulations. The number of segments can be readily varied in the input without any code modifications for up to 30 segments. In some cases a different number of segments may be desired, for example, if an automobile impacting a pedestrian is to be simulated, it is recommended that two more segments and joints (for the hands and connecting wrists) be added to accommodate the initial contacts of the hands with the hood of the impacting vehicle. Another common variation of the 15 segment body is to break the upper torso into two segments, jointed at the sternum to better accommodate motion of the shoulder complex.

Whatever the specific body model, the procedure to construct the body remains the same. The body is assembled as a chain of individual segments. For more complex bodies, as for the 15 segment body, the body can take on a tree-like structure, with several chains (here representing the arms and the legs) branching out from several connected segments. The principal limitation to this approach as implemented in the ATB Model is that no closed loop for interconnected segments should



Joint j connects segment JNT(j) with segment j+1

JNT(j)=	1	2	3	4	1	6	7	1	9	10	3	12	3	14
(j)=	1	2	3	4	5	6	7	8	9	10	11	12	13	14

Figure 1 Fifteen Segment Body Configuration

be allowed. An example of a closed loop would be if the two segments representing the right and left lower arms were to be connected by a joint. This would result in a closed loop composed (in the 15 segment body) of the upper torso, left upper arm, left lower arm, right lower arm and right upper arm.

The body segments and joints are assigned identification numbers, i = 1 to NSEG for the segments and j = 1 to NJNT for the joints. The assignment of the identification numbers is somewhat but not completely arbitrary. They are used along with the one-dimensional array, JNT(j) for j = 1 to NJNT, to define the connectivity of the segments by the joints. First, a base or reference segment is chosen as segment number 1. Although the reference segment may be any of the segments, it has been found that for the 15 segment body model the lower torso (LT) is the best choice for the reference segment. When the ATB Model was first developed, the head (H) was chosen as the reference segment. However, it was found that the erratic accelerations of the head caused numerical problems with the program integrator and that it was more beneficial to use a more stable, nonextremity segment, hence the choice of the lower torso as the reference segment. A generalization of this result is the recommendation that, regardless of the body model, the reference segment be chosen to be one that undergoes the least accelerations of any of the segments and/or is the heaviest segment.

Once the lower torso is selected as the reference segment and designated as segment number 1 the first joint must then be selected and numbered as joint no. 1. There are three segments, the center torso (CT), the left upper leg (LUL) and the right upper leg (RUL), that must be connected to the lower torso for the 15 segment body. Any one of the three joints that connect the above segments to the center segments can be assigned as joint number 1. Normally the joint connecting lower and center torsos is chosen as joint number 1. The requirement for sequential numbering of the segments results in the center torso being designated as segment number 2. The general logic behind this numbering scheme is the relationship JNT(j) = i, where "j" is the joint number, "i" is the segment number that is to be joined together with segment

number $j + 1$. JNT(j) is an array within the ATB program that stores the segment number of the proximal segment for the jth joint. In the context of the ATB Model, a proximal segment is the segment at a joint that is nearest to the reference segment whereas a distal segment is the segment further from the reference segment.

Successive segment and joint identification numbers are assigned with the provision that each new segment assigned be connected to a previously assigned segment (the corresponding restriction within the program is that the value of JNT(j) must be less than or equal to j). Continuing this process produces the identification and connectivity assignments of Table 1 as one possible arrangement. It is obvious that this arrangement is not unique.

The logic of connecting segment $j + 1$ to segment JNT(j) = i prevents the construction of closed chains via the joints. The restriction, JNT(j) $\leq$ j, allows for the possibility of specifying JNT(j) = 0. The ATB program utilizes this concept to signify that joint No. j will be a null joint and that segment No. j+1 will be the reference or base segment of another body. This permits the specification of multiple bodies that remain disconnected or free.

TABLE 1: Segment and Joint Assignments and Connectivity

i	Segment Name	Symbol	j	Joint Name	Symbol	JNT(j)	Connects
1	Lower Torso	LT	1	Pelvis	P	1	LT - CT
2	Center Torso	CT	2	Waist	W	2	CT - UT
3	Upper Torso	UT	3	Neck Pivot	NP	3	UT - N
4	Neck	N	4	Head Pivot	HP	4	N - H
5	Head	H	5	Right Hip	RH	1	LT - RUL
6	Right Upper Leg	RUL	6	Right Knee	RK	6	RUL - RLL
7	Right Lower Leg	RLL	7	Right Ankle	RA	7	RLL - RF
8	Right Foot	RF	8	Left Hip	LH	1	LT - LUL
9	Left Upper Leg	LUL	9	Left Knee	LK	9	LUL - LLL
10	Left Lower Leg	LLL	10	Left Ankle	LA	10	LLL - LF
11	Left Foot	LF	11	Right Shoulder	RS	3	UT - RUA
12	Right Upper Arm	RUA	12	Right Elbow	RE	12	RUA - RLA
13	Right Lower Arm	RLA	13	Left Shoulder	LS	3	UT - LUA
14	Left Upper Arm	LUA	14	Left Elbow	LE	14	LUA - LLA
15	Left Lower Arm	LLA					

2.2 REFERENCE COORDINATE SYSTEMS

The ATB model utilizes many reference coordinate systems with respect to which points in space and directions are calculated within the program. Considerable flexibility in the choice of coordinate systems and their specification for both input and output are available. The primary coordinate systems used in the model are the inertial, vehicle, local body segment, principal, joint and contact ellipsoid reference coordinate systems. The specification of each reference coordinate system requires an origin and a direction cosine matrix (usually initially specified by three rotation angles, yaw, pitch and roll) which relates one reference coordinate system with respect to another. All coordinate systems discussed in this section are orthonormal.

2.2.1 Inertial Reference Coordinate System

The ATB model assumes that the coordinates of the origin of the inertial reference coordinate are zero and all other coordinate systems are specified with respect to this system. The user may equate the origin of the inertial reference coordinate system to any convenient point from which his data are referenced. The frame of reference is arbitrary and is partially specified by defining which way is down by the values supplied for the components of the gravity vector. It has been customary to supply (zero, zero, g) as the components of the gravity vector to specify that the positive Z axis is pointing downward. Hence, in terms of a standing man, the force of gravity would be pointing in the direction from his head to his feet. The forward direction (pointing from the back of the standing man to his chest) is taken as the positive X axis and (by the right hand rule) the positive Y axis is in the lateral direction (pointing from the standing man's left side to his right side). However, the user may specify any frame of reference that suits his application, one with which he is more familiar, or in which his input data has been measured.

It is sometimes necessary that contact surfaces (planes or ellipsoids) be located with respect to the inertial reference coordinate system,

e.g., the ground for pedestrian simulations. Since the program assumes that contact surfaces are associated with segments, a special segment identification number (NGRND) is used within the program for this purpose. NRGND is the largest segment number used by the program and is assigned the value NGRND = NSEG + Number of air BAGs (NBAG) + number of vehicles + 1 and essentially corresponds to the inertial coordinate system. The linear position and velocity for this artificial segment are set to zero and its direction cosine matrix to the identity matrix throughout the duration of the program. This permits the use of segment NGRND for the attachment of contact surfaces.

2.2.2 Vehicle Reference Coordinate Systems

Up to six vehicles with specified motion can be defined. The primary vehicle is the last vehicle defined and is different from the other vehicles in that it serves as the default reference coordinate system for several types of input and output. Most of the contact panels are usually defined with respect to this system and much of the output (printer plots and tabular time histories) can be produced with respect to this system to correspond with photographs and drawings with respect to the vehicle. The origin of each of the vehicle coordinate systems is arbitrary, and any convenient reference point may be chosen for which input and output data would be most meaningful. The locations of the vehicle origins with respect to the inertial reference coordinate system origin are specified by XO. Again, the frames of reference (the directions of the positive X, Y and Z axes) are arbitrary and should be chosen to accommodate available input data. The initial velocities and direction cosine matrices are determined from the options available to specify vehicle motion.

A special segment identification number is assigned for each of the vehicles where NVEH1 = NSEG + 1, NVEH2 = NSEG + 2, etc. so that each vehicle may be treated like other segments for segment assignments for contact surface specifications. However, no matter how large the computed contact forces and torques are on these vehicle segments, the prescribed motion of the vehicle segment will not change.

2.2.3 Body Segment Local Reference Coordinate Systems

Each body segment has a local reference coordinate system which is sometimes referred to as the segment geometric coordinate system. Each body segment has a mass and principal moments of inertia. The local reference coordinate system has its origin at the segment mass center, the principal moments of inertia are with respect to this origin and the principal axes for the principal moments are specified with respect to the local reference system. The (hyper)ellipsoidal contact surface origin and orientation is also specified with respect to the local reference system. There is no direct association within the ATB model of the segment inertial properties and the (hyper)ellipsoidal contact surface that can be associated with the segment. Unlike the vehicle segments, a body segment can have up to six degrees-of-freedom and its kinematics are computed based on the dynamic interactions the body segment experiences during a simulation. A body segment can be given an initial position, orientation, and linear and angular velocity and its motion is then computed for the remainder of the simulation subject to any imposed constraints (e.g. number and type of joint) and applied forces. The motion of the body segments can not be specified unless the body segment is also defined as a vehicle.

To provide a means for the body segments to interact with the environment, one or more contact (hyper)ellipsoids can be attached to each body segment. These contact (hyper)ellipsoids are what the user sees in the various graphics of the ATB model and generally correspond closely to the physical dimensions of the actual object that is to be modeled by the body segment. The contact (hyper)ellipsoids have no mass or moments of inertia, they are solely for the purpose of providing the body segments with a means of interacting with surrounding environment. Contact planes can also be attached to the body segments to provide another way for the body segment to interact with the environment. While the orientation of the segment local reference coordinate systems can be arbitrarily defined, the standard convention has been to choose the axis so that when the body is in an upright standing position with

arms at the side, the Z axis is downward, the X axis to the front and the Y axis is to the body's right.

2.2.4 Body Segment Principal Coordinate Systems

The dynamic equations in the ATB model are solved in terms of principal axes. All three-dimensional bodies have an inertia tensor. Six of the nine inertia tensor elements are independent, therefore it is a second order, symmetric tensor. Any body has three principal directions for which there are three moments of inertia, corresponding to the diagonal elements of an inertia tensor when all the off-diagonal terms are equal to zero. The segment principal coordinate system axes correspond to the three principal directions, therefore only the three principal moments of inertia must be specified.

The principal axes are fixed with respect to the segment local reference axis and their orientation must be specified only once. All other model input and output referring to the segments is in terms of the body segment local reference coordinate system. After input, the ATB model converts all data points expressed in the local segment reference coordinate system to principal coordinates and, prior to output, back to the local segment reference coordinate system in a manner that is transparent to the user. Therefore, when the input description (Section 4.0) refers to local body segment reference, the local and not the principal moment of inertia reference coordinate system is implied. Note that for some cases where the principal axes are aligned with the local reference axes the two are coincident.

2.2.5 Joint Reference Coordinate Systems

Because of the mathematical formulations used by the joint force and torque computation subroutines within the program, it is necessary to define two coordinate systems for each joint, one rigidly attached to each of the body segments that are connected by the joint. As described above, these two body segments are identified as segments Nos. JNT(j) and j+1 for joint No. j. SR, the origin of each joint reference

coordinate system (or the location of the joint) is specified in the body segment local reference coordinate systems for both segment Nos. JNT(j) and j+1. The orientations of the joint axis systems are specified by rotation angles (yaw, pitch and roll) from the local frame of reference for both of these segments as YPR1 and YPR2.

Joint forces and torques are computed by the ATB program as a function of the relative orientation of the two coordinate systems at the joint. The joint coordinate system associated with the JNT(j) segment is used as the base reference system for determining the joint parameters. For pin joints the Y-axis is the axis of rotation. For ball and socket joints, free joints and joints using the joint function, flexure or theta is the angle between the two Z-axes while azimuth or phi is the angle between the base X-axis and the projection of the j+1 Z-axis into the X-Y base plane, and twist is rotation about the base Z-axis. For Euler joints precession, nutation and spin are defined as the rotations from the base joint coordinate system to the j+1 joint coordinate system. For slip joints, the linear motion is along the base Z-axis. Further descriptions of the joint types and their axes systems can be found in Volume 1 of Reference 4, Section 2 of Reference 2 and Section 6 of Volume 1 of this report.

2.2.6 Contact (Hyper)Ellipsoid Reference Coordinate Systems

The ATB model has an option to attach contact (hyper)ellipsoids to the body segments, vehicle segments or to the ground (inertial) segment. These contact (hyper)ellipsoids are for contact purposes only. They have no mass or moments of inertia and hence no dynamic response. They are rigidly attached to a segment at a point and with an orientation specified with respect to the segment's local reference coordinate system. The contact (hyper)ellipsoid coordinate system is formed by the three orthogonal semi-axes of the (hyper)ellipsoid, with the coordinate system's origin at the geometric center of the (hyper)ellipsoid.

The contact (hyper)ellipsoid is attached to a segment by specifying an offset vector which originates at the origin of the segment's local

reference coordinate system and ends at the point in the local coordinate system where the center of the contact (hyper)ellipsoid is to be attached. The orientation of the contact (hyper)ellipsoid is specified by rotation angles with respect to the local reference system. If no rotation angles are specified for the contact (hyper)ellipsoid, the X, Y and Z semi-axes of the contact (hyper)ellipsoid are assumed to coincide with the X, Y and Z axes of the local reference system of the segment to which the contact (hyper)ellipsoid is attached.

Contact hyperellipsoids can be used for hyperellipsoid/hyperellipsoid contacts and hyperellipsoid/plane contacts, but only simple ellipsoids can be used for belt/ellipsoid contacts, harness belt/ellipsoid contacts or air bag/ellipsoid contacts (where the air bag is a special type of contact ellipsoid). More that one contact (hyper)ellipsoid can be attached to one local (body, vehicle or ground) segment. The contact ellipsoids originally defined with the segments are those depicted by the VIEW program. Additional contact (hyper)ellipsoids specified later in the input can not be drawn by the current version of the VIEW graphics program (Ref. 6).

The only input data specified in terms of the contact (hyper)ellipsoid coordinate system, besides the (hyper)ellipsoid semi-axes, are those for the simple belt and harness belt algorithms. The belt points that contact the surface of a contact ellipsoid are specified in terms of the contact ellipsoid coordinate system. This is a physically realistic situation since one would expect both the simple and harness belts to lie on the surface of a body segment, which is modeled as a contact ellipsoid.

2.2.7 Applied Force and Torque Coordinate Systems

The ATB model has the capability to apply time-dependent forces and torques to body segments. A force/torque coordinate system is defined such that a positive force is applied in the positive X direction of the force/torque coordinate system and a positive torque is applied about the positive X axis of the force/torque coordinate system using the

right hand rule. The origin and orientation (rotation) of the force/torque coordinate systems are specified with respect to the local reference coordinate system of the segment to which the force/torque is to be applied.

2.3 DIMENSIONAL UNITS AND GRAVITY

Before any body or vehicle data can be considered for input to model, the user must decide which units of measurement are to be used for the simulation and in which direction, relative to the inertial system, the gravity field is to point.

2.3.1 Selecting Dimensional Units

The units of measurement for the input data (i.e. pounds/inches/seconds or newtons/meters/seconds) must be chosen. The choice is arbitrary and there is no default, but once the selection is made, all input data must be in the same units. Choosing the units of measurement for the input data also automatically specifies the units for the output data. The units of measurement are selected by supplying the alphanumeric names of the abbreviations for the units of force (UNITM), distance (UNITL) and time (UNITT). These input parameters are used to annotate the ATB model output, including the listing of the input on the primary output file (FORTRAN logical unit 6).

The units of measurement used in the ATB Input Description for illustrative purposes are pounds, inches and seconds. These units were selected at the time of the initial development of the model when most available data were in these units. These particular units were selected on the basis of convenience only and should not be considered as the standard units. Although there are no official units, the format (field width and number of digits following the decimal) for various output items were established on the basis of the expected magnitude of output for a simple car crash type simulation, assuming the pound, inch

and second measurement system. Hence it is possible that a different choice of units may result in output that, while numerically correct, may not have the desired output format.

Note that mass units are not required for input and output purposes, although they are assumed internally by the program. This is accomplished by supplying the weight of the body segments using the force units. The ATB program converts these input values to mass units by dividing these force units by the value of the acceleration due to gravity which must be provided as input. Unfortunately, an inconsistency was introduced during the early development of the program for the input units required for the principal moments of inertia (PHI). In retrospect, the units for the principal moments of inertia should have been weight (force) multiplied by distance squared, and the input values converted by the program by dividing by the acceleration due to gravity, as is done for the segment weights. As the input is now established, the required units for these principal moments of inertia are weight (force) multiplied by distance multiplied by time squared, which is equivalent to mass multiplied by distance squared. This inconsistency has never been removed because its removal would invalidate many already established input files.

2.3.2 Specifying Gravity

Once the units of measurement have been selected, the user must next define what is meant by the inertial coordinate system. As discussed earlier the inertial coordinate system is the coordinate system to which all other coordinate systems are referred and it is within this system that Newton's laws hold. The inertial coordinate system of the model is assumed to be at rest, but is designated as a segment called the ground segment with its segment number given by NGRND. Defining the inertial coordinate system means specifying which direction, with respect to the inertial coordinate system, is considered to be "up" and which direction is considered to be "down".

Most whole body simulations have had "down", meaning the direction an object would travel if subjected to gravity alone, aligned with the positive Z axis. This would be specified in a simulation as defining the gravity vector GRAVTY, as (0, 0, g) where g corresponds to the standard coefficient of gravity at the surface of the earth.

The gravity field defined by GRAVTY is assumed to be constant throughout space and time in the ATB model and is applied to all segments that are given a nonzero weight. The magnitude of the vector GRAVTY is used to compute the masses of the segments from their supplied weights. If the user wants to simulate the motion of an object in a zero gravity field, such as a spacecraft in deep space, the gravity vector would be supplied as GRAVTY (0, 0, 0). The magnitude of this vector is obviously zero so computation of the masses of the segments from their weights would not be possible using the magnitude of GRAVTY. To circumvent this problem, the user has the option of supplying G. G represents a factor by which the weights of the segments will be divided to yield a mass. If G is supplied as nonzero, the ATB program will use the value of G rather than the magnitude of GRAVTY to compute the masses of the segments. G must be nonzero when GRAVTY (0,0,0) is used. For the case when the magnitude of GRAVTY is nonzero and G is also nonzero, the program will apply the vector GRAVTY to all segments with a nonzero mass but the weights of the segments will be converted to mass by dividing by G.

2.4 INITIAL POSITIONING OF THE ATB SEGMENTS

In addition to the specification of the inertial properties and coupling scheme of the segments, the initial position and velocity of the body segments must be provided. The ATB program requires the initial position of the c.g. of the base or reference segments in the inertial reference coordinate system and the initial orientation of each local body segment to be specified. For the total body free in space this process can be relatively straight forward, however, when body interactions with the surrounding environment (for example, seat and floorboard contracts) have to be taken into account the process can become fairly involved. The reason for this is that the body must

initially be in static equilibrium and this equilibrium depends on the balancing of gravitational forces by contact forces. The latter are highly position dependent and must be properly chosen to avoid large initial segment accelerations. Two general methods can be used to achieve initial equilibrium. The first is an iterative adjustment process and the second uses an internal equilibrium routine.

2.4.1 Iterative Positioning Method

The iterative method requires initial prescription of the initial position and then the execution of a simulation to zero time. This can be done by setting NSTEPS to zero, and by supplying a nonzero value for NPRT(3). A tabular printout of all of the external forces and torques and resulting linear and angular positions and accelerations is produced for time zero. Then the user adjusts the positions based on the initial angular and linear accelerations and the contact forces. This procedure usually requires several iterations to insure that the body is in static equilibrium with its environment which is determined by the absence of large accelerations for any of the body segments. Perfect equilibrium is generally not attainable for the seated or standing position, however, small initial accelerations are tolerable, especially if they are much smaller than the accelerations induced by the dynamic environmental conditions under study.

2.4.2 The Equilibrium Routine

An equilibrium option has been incorporated into the ATB program to assist the user in achieving this initial equilibrium of the body segments. It has been designed in a general manner to solve any equilibrium problem, but can be exceedingly complex to use. The input description (Section 4.0) describes a procedure designed at Calspan that produces equilibrium (zero accelerations on all body segments) for a typical seated occupant configuration. It utilizes an automatic multiple iteration procedure that simulates the adjustments a body makes to comfortably seat itself inside an automobile seat configuration. It is suspected that the resulting configuration is unique for the set of

specified contact forces desired. To adapt this procedure to other configurations, it is necessary that the body segments not be over or under constrained as determined by the contacts allowed, locked joints and the imposition of rolling and sliding constraints. Supplying the proper input for the general case is not a simple matter, but following the instructions described in the input description should greatly assist the initial positioning of a seated occupant in a standard automobile or ejection seat configuration.

2.5 TIME AND OUTPUT CONTROL OF THE ATB PROGRAMS

Time control parameters must be specified for each simulation. These parameters control the length (simulation time) of the run, the amount and format of the output, the tabular time histories, and operation of the program integrator. Although the program places no restrictions on these input parameters, a judicious choice of the parameters can improve calculational efficiency and numerical stability.

The primary control of time is performed by the Main Program of the ATB program. Here, after all input and initialization is performed, time is advanced in steps of DT seconds by calling the program integrator. After each DT time step, control is returned to the main program where the print indicators NPRT(1) thru NPRT(7) are tested to perform optional outputs. This is done for time zero and at each integral (one thru NSTEPS) multiple of DT seconds of simulation time. The total simulation time is therefore NSTEPS*DT seconds where NSTEPS and DT are input parameters. The values of NSTEPS and DT should therefore be chosen so as to provide the desired length of the simulation and amount and frequency of output data.

A secondary control of time is performed by the program integrator, subroutine DINT. This is controlled by the supplied values for HO, HMIN and HMAX. The integrator advances time in substeps of H seconds starting with HO and varying between HMIN and HMAX. H is halved when convergence of the integrator parameters is not achieved, but H is not permitted to become less than HMIN. If convergence is not attained with

a HMIN time step the simulation stops. If the convergence criteria are satisfied for several integration steps, H is increased by 2. This can continue until the integration step reaches HMAX. Although not absolutely required, it is best that DT be chosen an integer multiple of HMAX so that the DT time step will be executed in equal HMAX substeps during periods of stable activity. Also, since the value of H is permitted to double during these stable periods or be halved during unstable periods, the integrator will execute more efficiently if HMAX is a power of two multiple of HMIN and HO.

It has been observed that suitable values for HMAX lie between one and five msec for most occupant and pedestrian simulations. Generally, values for DT of 0.002, 0.004, 0.010 or 0.020; HMAX of 0.001 or 0.002; and HMIN and HO of 0.000125 or 0.000250 seconds work satisfactorily. It is possible to execute the integrator in a "fixed step mode" by setting HMAX = HMIN = HO, but this is not recommended.

One other input parameter is worth mentioning here, namely NDINT. The integrator basically performs NDINT iterations of functional evaluations at both the midpoint (TIME + H/2) and endpoint (TIME + H) of the current time substep with convergence being tested after each endpoint evaluation. Although some writers have suggested that only one is necessary for the value of NDINT, it has been observed that an even number works better (because of the behavior of the integrator) and that extra evaluations, in an attempt to achieve convergence, are less costly than permitting the integrator to halve the time step. Therefore, a value of 4 or 6 for NDINT is recommended.

3.0 ORGANIZATION OF ATB INPUT DATA

The input for the ATB program is contained in a single primary input file (FORTRAN Unit No 5). It is a formatted file, structured in a fixed 80 column card format of alphanumeric data input. Each record of the file therefore corresponds to the contents of an input card that has a unique identification (e.g. input Card A.1.a). This produces a modular form for the contents of an input file for the ATB program. For example, the A input cards contain the general run parameters, the B input cards contain the inertial and geometric parameters that define the segments and joints of the body, the C cards contain the parameters that define the vehicle motion, etc. Since most computer systems permit the concatenation of files, the input file for the ATB program could possibly consist of several previously constructed files that are concatenated in the proper sequence at execution time. The modularity of the input makes it possible for complete sets to be replaced by existing sets that have been previously used.

The ATB program has innumerable options available to the user, and each characteristic generally consists of a predefined number of parameters. For example, the crash victim body consists of a variable number of segments and joints specified by NSEG and NJNT supplied on input Card B.1 that, in turn, control the number of B cards to follow. Therefore, the structure of any ATB program input file or deck is variable and is completely specified by previously supplied parameters. Some input cards are always required, others are needed only for previously specified parameters, and, in most cases, the number of cards within any given set is determined by a previously defined parameter. Because of this variable structure for the input deck, a fixed format for the program input that is common for many computer programs was not used. In fact, ATB program input decks may be as small as 15 or 20 cards and as large as 700 or 800 cards.

During the input portion of the ATB program, considerable program initialization is performed that, in some cases, changes the actual

supplied input (e.g., degrees are converted to radians) and a completely annotated listing of the program input is produced on the primary output unit (FORTRAN unit No. 6). It is suggested that, as one first attempts to read the input description for the ATB program (Section 4.0), they have one of the primary output listings available to assist in the initial understanding of the many program features that are available and the manner by which they are controlled within the program.

Following is a summary of all of the input cards. A complete description, giving the format for each card, the conditions that specify its necessity, the input parameters to be supplied on each card and a definition of each of these parameters, is presented in Section 4.0.

A. Run control parameters

A.1.a-c	Date, restart control, run description
A.2	Variable changes for restart procedure
A.3	Dimensional units, components of gravity
A.4	Integrator parameters
A.5	NPRT array for output control

B. Physical characteristics of the body

B.1	Body title, No. of segments and joints
B.2.a-b	Physical characteristics of body segments
B.3.a-b	Physical characteristics of joints
B.4	Joint spring function coefficients
B.5	Joint viscous function coefficients
B.6	Integrator convergence tests for body segments
B.7.a-b	Controls for flexible elements

C. Prescribed segment (vehicle) motion

C.1	Vehicle motion title
C.2.a-b	Prescribed motion control parameters

C.3 Unidirectional deceleration tables

C.4 Six degree of freedom deceleration tables

C.5 Spline fit tables

D. Contact surface and other environment definitions

D.1 Number of contact panels, belts, airbags, etc.

D.2.a-d Plane description and input data

D.3.a-c Simple belt description and input data

D.4.a-b Airbag description and input data

D.5 Additional (hyper)ellipsoid contact surface input data

D.6 Constraint and tension element input data

D.7 Body segment symmetry options

D.8 Spring damper input data

D.9 Applied force/torque function input data

E. Function definitions

E.1 Function identification number and title

E.2 Function definition control parameters

E.3 5th degree polynomial coefficients

E.4.a-b Tabular function definition

E.5 (No longer required by program)

E.6.a-d Wind force functions input data

E.7.a-d Joint force functions input data

F. Allowed contacts and associated functions

F.1.a-b Menu for plane-segment contact functions

F.2.a-b Menu for belt-segment contact functions

F.3.a-b Menu for segment-segment contact functions

F.4.a-b Specifications for globalgraphic joint functions

F.5.a Specifications for joint forces option

F.6	Allowed airbag-segment contact definitions
F.7.a-b	Wind force functions specifications
F.8.a-d	Harness-belt systems input data

G. Initial positioning input

G.1.a-b	Printer plots control parameters
G.2	Initial position and velocity for reference segments
G.3.a-b	Initial segment angular orientation and velocity input data
G.4	Equilibrium control parameters
G.5	Equilibrium control assignments
G.6	Equilibrium constraint assignments

H. Tabular time history output control parameters

H.1.a-b	Linear accelerations of selected points on segments
H.2.a-b	Linear velocities of selected points on segments
H.3.a-b	Linear positions of selected points on segments
H.4	Angular accelerations of selected segments
H.5	Angular velocities of selected segments
H.6	Angular orientations of selected segments
H.7	Joint parameters for selected joints
H.8	Wind forces on selected segments
H.9	Joint forces and torques for selected joints
H.10.a-b	Properties of selected sets of segments
H.11	Parameters for HIC, HSI and CSI computations

I. Specifications for Calcomp plots

I.1	No. of plots and Y variables per plot
I.2	X and Y variables to be plotted
I.3	Parameters for horizontal (X) axis
I.4	Parameters for vertical (Y) axis

I.5	X axis label
I.6	Y axis label
I.7	First line of plot label
I.8	Second line of plot label

4.0 INPUT DESCRIPTION FOR THE AAMRL ARTICULATED TOTAL BODY MODEL ATB-IV.0 JULY 1988

The following is an input description for the Articulated Total Body (ATB) Model. Both the input description and ATB Model are available from the Modeling & Analysis Branch, Biodynamics & Bioengineering Division, Armstrong Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Dayton, Ohio 45433-6573, [(513) 255-3665]. The ATB Model is the Air Force sponsored enhanced version of the Crash Victim Simulator (CVS) Model developed by Calspan for the Department of Transportation. All revisions and enhancements to previous versions of the ATB Model are denoted by the symbols below.

i.1 Symbol Key:

A line with any of the symbols '!', '@', '%' or '#' to the right of it indicates that a change has been made to the input description since the version described in Calspan Report No. ZS-5881-V-3, 'Validation of the Crash Victim Simulator', Volume 3, User's Manual, February 1982.

The symbol '!' indicates that a change has been made to the input description to correct, clarify or update the text of the input description or to make the input description more consistent with the ATB code. It does not indicate a change to the actual input to the ATB Model.

The symbol '@' indicates that a change has been made to the input description for an already existing card in such a manner that previous input decks are still acceptable as proper input for the current version of the program if no modification is made to the previous input deck. The symbol '@' essentially indicates a new feature or option of the ATB program that is not affected by previous input decks unless the input necessary to activate these features is included in the input deck.

The symbol '%' indicates that a card has been added to the ATB Model input in such a manner that previous input decks are still acceptable as proper input for the current version of the program, provided that a blank card is inserted where the new card is required.

The symbol '#' indicates that changes in format or content are required to previous input decks to be acceptable as proper input for the current version of the program.

The following additional special symbols are used throughout the report:

> '#' is used to indicate 'not equal'.
> '<' is used to indicate 'less than'.
> '>' is used to indicate 'greater than'.
> '|' is used to indicate 'absolute value'.

i.2 Revisions and Updates

This version of the ATB Input Description has been reformatted to permit individual pages to be updated without requiring that the entire input description be reprinted. Therefore, future updates will include only those pages affected and a complete new input description will not be printed. Any change symbol on pages with revision number IV.0 denote changes to the input description from the Calspan report mentioned above. Future updates will be designated with a revision number on the specific page of the change. The first page of the input description will also be updated for each revision to show the current version number of the input description.

i.3 Description of FORTRAN FORMAT Statements Used

At the beginning of the description of each card appears the FORTRAN FORMAT statement that specifies the structure of the input image for that card. The only format codes used by the ATB program are:

nFw.d	(F to describe real data fields)
nIw	(I to describe integer data fields)
nAw	(A to describe alphanumeric data fields)
wX	(X to indicate a field to be skipped)

where: n, w and d are unsigned integer constants

n - is optional and is a repeat count used to denote the number of times the format code is to be used. If n is omitted, a value of one is assumed and the code is used only once.

w - specifies the field width (number of columns on the card).

d - normally specifies the number of decimal places to the right of the decimal point, i.e., the fractional part of the number. However, a decimal point supplied within the field will override the d specification.

/ - is used to indicate the end of a card image and that the remaining fields are to be supplied on a succeeding card.

All variable names used follow the standard FORTRAN naming convention, i.e., those variables where the first letter of their name is A-H or O-Z are real (actually double precision on IBM, UNIVAC, Data General and P-E computers and single precision on CDC computers) and those with I-N as their first letter are integer.

All real data have a Fw.0 format code which requires the use of a decimal point within the specified field to override the d=0 specification. On most computers F, D and E format codes are completely interchangeable for input which permits one to supply an exponential (power of ten) multiplier; e.g., 0.000001 may be supplied as 1.0D-6, provided that the exponential term is right adjusted within the field width. In all other cases, real data using the Fw.0 format code may appear anywhere within the field width. All blanks are assumed to be a zero and therefore ignored. A blank field will therefore input a value of zero.

All integer data use a Iw format code and must be right adjusted, i.e., must appear in the rightmost columns of the field.

Several names, titles and other descriptive items are alphanumeric data and use the Aw format code. Here blanks are spaces and the actual characters desired may appear anywhere within the field.

The use of the symbol ** for any format such as: FORMAT (20A4 /20A4)** indicates that columns 73 - 80 of that card are used for input and should not be used for identification purposes.

OUTLINE OF INPUT TO THE PROGRAM

Cards A - Date and run description, units of input and output, control of restart, integrator and optional output.

Cards B - Physical characteristics of the segments and joints.

Cards C - Description of the vehicle motion.

Cards D - Contact planes, belts, air bags, contact (hyper)ellipsoids, constraints, symmetry options, spring dampers, and prescribed forces and torques.

Cards E - Functions defining force-deflections, inertial spike, energy absorption factor, and friction coefficients.

Cards F - Allowed contacts among segments, planes, belts, airbags, contact (hyper)ellipsoids and harnesses.

Cards G - Initial orientations and velocities of the segments.

Cards H - Control of output of time history of selected segment motions, joint parameters, wind forces, joint forces and torques, total body properties, and injury criteria.

Cards I - Control information for plotter output.

A. Main Program Input

Card A.1.a	FORMAT (3A4, 2I4, F8.0)
DATE(I),I=1,3	Date of the run (12 characters).
IRSIN	Restart input unit No. If blank or zero, all input to be supplied on cards A.3 to CARDS H.10. If nonzero (suggested value = 4) input will be supplied from a previous restart tape and Cards A.1.b, c and A.2.
IRSOUT	Restart output unit No. If nonzero (suggested value =3), records will be written on this output unit for future restart runs. An initial record containing all input and initialization data will be written plus a time point record at every time interval as specified by DT on Card A.4.
RSTIME	Restart time (sec.) required if IRSIN ≠ 0. Should be nonzero and an integer multiple of DT on Card A.4. Program will read records from the previous restart tape up to and including this time, make changes per card A.2, and continue operation from there.

Cards A.1.b - A.1.c	FORMAT (20A4 / 20A4) **
COMENT	Description of the run (160 characters on two cards).

Cards A.2 are required only if IRSIN > 0, in which case all other input as specified on Cards A.3 to H.10 are bypassed. Two sets of A.2 (each terminated with a blank card) are required. The first set is processed after the initial input record is read from input unit IRSIN and, if IRSOUT ≠ 0, before the input record is written on output unit IRSOUT. The second set is processed after the time point record for TIME = RSTIME has been read and, if IRSOUT ≠ 0, after the same record is written on output unit IRSOUT, but before the program resumes operation.

Cards A.2	FORMAT(A8, 4I4, 2(F8.0, I8, A8))
AVAR	Alphanumeric name (left adjusted in field) of variable to be redefined for restart. Program is capable of changing most variables in the labeled common blocks as used after all initialization has been performed. The user should ascertain that changing this variable is valid for the program.
INDEX(I),I=1,3	The array indices, if any, of the variable. Must agree in number and the values must be less than or equal to the dimensions of the variable. Blank or zero for no dimension.
ITYPE	Supply 1, 2 or 3 to indicate that the new value is to be real(RR), integer(II) or alphanumeric(AA). Must agree with the type of the variable within the program.
RR, II or AA	New value of the variable AVAR to be supplied in the appropriate field determined by the value of ITYPE.
RROLD, IIOLD or AAOLD	The previous value of the variable AVAR in the appropriate field according to the ITYPE value. Integer or alphanumeric data will be tested exactly, real data to 5 significant digits. If the current value is different, the program will terminate with an error message. If zero or blank is supplied, no check is performed.

These A.2 Cards will be processed until a blank value for AVAR is encountered. No further input is required.

Card A.3 FORMAT (3A4, 4F12.0)

UNITL — Label for unit of length (4 characters).

UNITM — Label for unit of force (4 characters).

UNITT — Label for unit of time (4 characters).

Note: UNITL, UNITM and UNITT can be any set of consistent units, however, throughout this description, inches, pounds and seconds (in,lbs,sec) are used as sample units. If other units are used, the field widths of some output format statements may have to be changed.

GRAVTY(I),I=1,3 — The x, y and z components (in/sec**2) of the gravity vector in the inertial coordinate system. Typically, the vector (0,0,g) is used. This defines gravity to be applied along the positive inertial z axis. Any vector may be used, including (0,0,0) for a weightless environment.

G — The value of the constant (in/sec**2), which the input segment weights will be divided by to obtain their mass. If blank or zero, the magnitude of the gravity vector will be used. G must be nonzero if GRAVTY = (0,0,0).

Card A.4 FORMAT (2I4, 4F8.0)

NDINT Number of iterations for the final convergence test of the integrator Subroutine DINT (minimum value = 2, suggested value = 4).

NSTEPS Number of output time points. May be zero to obtain initial conditions.

DT Main program time interval for integrator routine output (sec). The total time of the run will be NSTEPS*DT seconds. Program output can be obtained every DT seconds or integer multiples of DT. Note: The value of DT can affect simulation results (since the integrator is forced to provide output at every integer multiple of DT), in addition to regulating the frequency of output data.

H0 Initial integrator step size (sec).

HMAX Maximum integrator step size (sec). For best efficiency DT should be an integral multiple of HMAX and HMAX a power of two multiple of H0. (Suggested value = 0.001 sec.)

HMIN Minimum integrator step size (sec). If a fixed step size is desired, set HMIN greater than HMAX, and step size will double from H0 until HMAX is achieved.

Card A.5 FORMAT (36I2)

NPRT(I), I=1,36 An array of indicators that control various optional output and program control features of the program. Generally, for the output parameters, a blank or zero value indicates no output for that item and a value of one will produce output each time the routine is executed. The printed output, produced by elements 8-17 and 20-25 is intended for diagnostic or 'check out' purposes only, can produce large amounts of partially labeled output and should not be used for long or production runs. One should consult the listing of the subroutine for a description of the diagnostic items that are printed.

The NPRT array (* - see notes below)

Element No.	Subroutine	Output produced
1 (1*)	MAIN	Output unit No. 1
2 (1*)	MAIN	Subroutine ELTIME table
3 (1*)	MAIN	Subroutine PRINT output
4 (2*)	OUTPUT,POSTPR	Output unit No. 8, plots
5 (1*)	PRIPLT	Y-Z view printer plots
6 (1*)	PRIPLT	X-Z view printer plots
7 (1*)	PRIPLT	X-Y view printer plots
8 (3*)	DAUX	IJK, RHS and C arrays
9	DAUX	Subroutine PRINT output
10	IMPULS	Diagnostic output
11	SETUP1	U2,V1 arrays
12	VISPR	Diagnostic output
13	PRIPLT	CJOINT array
14	WINDY	Wind forces
15	BELTG	Diagnostic output
16	HBELT	Harness-belt forces
17	EDEPTH	Diagnostic output
18 (4*)	OUTPUT,POSTPR	Limit tabular time histories
19	not used	
20	CHAIN	SEGLP,SEGLV
21	AIRBAG	Diagnostic output
22	AIRBG1	Diagnostic output
23	BINPUT	HT and HB arrays
24	UPDATE	Roll-slide test output
25	DINT	Convergence test data
26 (5*)	DINT,POSTPR	Tabular time history output
27	EQUILB	Intermediate results

Card A.5 (continued)

28 (6*)	HPTURB	Harness belt forces	
29	not used		
30 (7*)	POSTPR	Plot and HIC data frequency	●
31 (8*)	POSTPR	Type of plot output device	●
32	not used		
33	not used		
34	not used		
35	not used		
36 (9*)	DRIFT	Controls drift of joints	●

Notes concerning elements of the MPRT array

1* For elements 1, 2, 3, 5, 6 and 7, the value indicates the frequency of output. Zero will produce no output (for element No. 2, the ELTIME table will be printed once at the end of the run) and a non-zero positive value (N) will produce output every N*DT (from Card A.4) seconds.

Card A.5 (continued)

2* The value of NPRT(4) is used (after version 18A) to control:

(1) Write the tabular time histories (specified by Cards H and the allowed contacts on Cards F) on either
   (a) the multiple output units (No. 21 and up) by Subroutine OUTPUT, or
   (b) the primary output unit (No. 6) by Subroutine HEDING.

(2) Store the time history data on output unit No. 8 by Subroutine OUTPUT to be later used by Subroutine POSTPR.

(3) Generate plots of the time history data (specified on Cards I) by Subroutine POSTPR.

Permissible values of NPRT(4) range from -3 to +4 as follows:

	Supplied value for NPRT(4)								
	+4	+3	+2	+1	0	-1	-2	-3	
1 Control Cards									
Multiple output units	yes	no	no	yes	yes	no	no	no	
Output unit No. 8	yes	yes	yes	yes	no	yes	yes	yes	
2 Card Input									
Cards B.1-H.10	yes	yes	yes	yes	yes	no	no	no	!
Card H.11	no	yes	yes	yes	no	yes	yes	yes	!
Cards I	no	yes	no	yes	no	yes	no	yes	
3 Main Program Operation									
Integrate and/or restart	yes	yes	yes	yes	yes	no	no	no	
Call Subroutine POSTPR	no	yes	yes	yes	no	yes	yes	yes	
4 Print time histories									
Multiple output units	yes	no	no	yes	yes	no	no	no	
Primary output unit	no	yes	yes	no	no	no	yes	yes	
5 Output unit No. 8									
Write (Sub OUTPUT)	yes	yes	yes	yes	no	no	no	no	
Read (Sub POSTPR)	no	yes	yes	yes	no	yes	yes	yes	
6 Generate plots (Cards I)	no	yes	no	yes	no	yes	no	yes	

Note: If NPRT(4) is negative, input Cards B.1-H.10 should not be supplied. !

Card A.5 (continued)

3* A value of NPRT(8) = 2 will print the designated arrays before and after the first call to Subroutine FSMSOL only.

4* The value of NPRT(18) controls the printing of the tabular time histories not specified by the H Cards. A value of NPRT(18) = 0 will result in the printing of all the tabular time histories, as in previous versions of the model. None of the tabular time histories listed below will be printed for a value of NPRT(18) = 16. The table below lists which time histories that will be printed for the other values of NPRT(18). The types of time histories are labeled with 'y' for yes, indicating this tabular time history will be printed and 'n' for no, indicating it will not be printed.

	Supplied value of NPRT(18)																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Plane/seg	y	n	y	y	y	y	y	n	y	y	n	n	y	y	n	n	n
Belt/seg	y	y	n	y	y	y	y	n	n	n	y	y	y	n	n	n	n
Harness-belt	y	y	y	n	y	y	y	y	n	n	y	n	y	n	n	y	n
Spring-dmprs	y	y	y	y	n	y	y	y	y	n	y	y	n	n	n	n	n
Seg/seg	y	y	y	y	y	n	y	y	y	y	n	n	y	n	y	n	n
Airbag	y	y	y	y	y	y	n	y	y	n	y	y	n	n	n	n	n

Card A.5 (continued)

5* NPRT(26) controls the frequency of the tabular time history output. Values of -9 through 6 are permissible.

(a) If the tabular time histories are printed on the multiple output units 21 and up (NPRT(4) = 0,1 or 4), the value of NPRT(26) controls the frequency of the output as follows:

<0 - print one line every |NPRT(26)*DT| seconds;
0 - print one line every DT (from Card A.4) seconds;
1 - print at the end of each successful integration step;
2 - print at every intermediate time point of each step.
3 - print one line every DT (from Card A.4) seconds;
4 - no lines are printed;
5 - print at the end of each successful integration step;
6 - no lines are printed.

(b) If output unit No. 8 is generated (NPRT(4) > 0), records are written to output unit No. 8 as follows:

<0 - every |NPRT(26)*DT| seconds;
0 - at the end of each successful integration step;
1 - at the end of each successful integration step;
2 - at each intermediate time point of each step;
3 - every DT (from Card A.4) seconds;
4 - at the end of each successful integration step;
5 - no records are written (output unit No. 8 not used);
6 - no records are written (output unit No. 8 not used).

(c) If the tabular time histories are printed from output unit No. 8 (NPRT(4) = +2,+3,-2 or -3), a value of NPRT(26) equal to:

<0 - print one line every |NPRT(26)*DT| seconds;
0 - print one line every DT (from Card A.4) seconds;
1 - print at the end of each successful integration step;
2 - print at every intermediate time point of each step;
3 - print one line every DT (from Card A.4) seconds;
4 - no lines are printed;
5 - no lines are printed;
6 - no lines are printed.

Card A.5 (continue)

Note: The rational for using the above options is as follows: Previous input decks will produce the same output, i.e. NPRT(26) = 0,1,2 responds as before. To reduce the size of the scratch file (output unit No. 8) use NPRT(26) = 3 or <0. Use NPRT(26) = 4 to create a TAPE 8 file that is to be saved and used for a postprocessing run where the tabular time histories and/or plots will be made during the postprocessing run. NPRT(26) = 5 & 6 are primarily for debugging purposes. Note that if NPRT(26) = 3 or <0 and NPRT(4) = +1,+3,-1, or -3, (plots to be computed) the data written to TAPE 8 will be .GE. DT*|NPRT(26)|, hence the frequency of the plots, NPRT(30), must be .GE. |NPRT(26)|.

6* NPRT(28) controls the frequency and amount of harness belt force output produced. Values of 0, 1, 2 and 3 are allowed as follows: (each value includes output for all lower values)

(0) - Produces a table of the final harness belt forces at each point in play at the same time points as output is produced by Subroutine PRINT as specified by NPRT(3).

(1) - Prints a table of the final harness belt forces at each point in play at each time point of Subroutine HPTURB.

(2) - Prints a table of the harness belt forces at each point in play for every iteration step of Subroutine HPTURB.

(3) - Prints the RHS,IJK and C arrays before the call to FSMSOL at each iteration step at each time point of HPTURB.

7* NPRT(30) controls the frequency of the data points for plotting, as specified by the I Cards, and for use in the computation of the HIC, CSI and HSI numbers, as specified by Card H.11. A value of NPRT(30) equal to:

0 - plot variable for every successful integration step;
>0 - plot variable every NPRT(30)*DT seconds.

Note: NPRT(30) must be .GE. NPRT(26) if plots are to be made. Refer to the note for NPRT(26) for further information.

Card A.5 (continue)

8* NPRT(31) controls whether the plots generated by the I cards will have a page advance. The use of the page advance will depend on the the type of device the plots are to be drawn on. For NPRT(31) equal to:

0 - pages will be advanced. Required for drum plotters.
1 - pages will not be advanced. Required for terminals and single-sheet plotters.

9* A nonzero value for NPRT(36) triggers Subroutine DRIFT to recompute the direction cosine matrices and angular velocity of adjacent segments connected by constrained joints so as to prevent drift of the constrained joint axes. No diagnostic output is produced.

B. Subroutine BINPUT

Card B.1	FORMAT (2I6, 8X, 5A4)	
NSEG	The number of segments. The maximum value for the sum of NSEG, number of airbags (NBAG on card D.1), number of vehicles defined on the C cards and one for the ground is 30. A minimum of 1 segment is required.	!
NJNT	The number of joints (maximum = 30).	!
BDYTTL	Description of the crash victim (20 characters).	

Cards B.2.a FORMAT (A4, 1X, A1, 10F6.0, I4)
(NSEG cards)

Each card (I) for I = 1, NSEG will contain input data for the Ith segment. The segment identifying numbers (I) will be referred to on later input cards.

SEG(I)	An abbreviation of the nomenclature of the Ith segment (4 characters).
CGS(I)	The plot symbol of the segment center-of-mass (1 character). !
W(I)	The weight of the segment (lbs).
PHI(J,I),J=1,3	The principal moments of inertia of the segment about the x, y, and z axes of the segment (lbs-sec**2-in). There are no restrictions for the values of W(I) or PHI(J,I), they may be negative or zero. If any component is zero, it is assumed that the system is suitably constrained so that the system matrix is nonsingular.
BD(J,I),J=1,3	The x, y, and z semiaxes of the segment contact ellipsoid (in).
BD(J,I),J=4,6	The location of the center of the segment contact ellipsoid, with respect to the center-of-mass of the segment, in the local body segment reference(in). These primary contact ellipsoids are given the same identifying number as the segment. They may be redefined with an arbitrary orientation on Cards D.5. !
LPMI(I)	An integer which, if non-zero, indicates that the principal axes for segment No. I are rotated from the local refererence axes. If LPMI(I) ≠ 0, a B.2.b card must immediately follow this Card B.2.a. If LPMI(I) is zero or blank, Card B.2.b is not required. ! ! ! !

Note: To handle situations where the principle axes are not aligned with the local axes, set LPMI = 1. This indicates that the principal axes are rotated from the local reference axes for segment No. I and that an additional input Card B.2.b must immediately follow to specify the rotation. Since it is desirable that input defining points on a segment be supplied with respect to the local reference axes and, also, not to invalidate previous input decks, the program (Subroutine ROTATE) will transform all data that has been defined with respect to the local reference axes to the principal axes in a manner that is transparent to the user. Also, all standard output, where applicable, will be transformed back to the local reference axes.

Cards B.2.b FORMAT (12X, 3F6.0)

YPRPMI(J,I), J=1,3	The yaw, pitch and roll angles in degrees of the principal axes with respect to the local reference axes of segment No. I.

If NJNT is zero on Card B.1, Cards B.3 - B.5 are not required.

Cards B.3.a FORMAT(A4, 1X, A1, 2I4, 6F6.0, I4, 2F6.0)

(NJNT sets of cards are required, 2 cards per set. The first card (B.3.a) of each set is described below and the second card's (B.3.b) description follows.)

Each card (J) for J = 1, NJNT will contain input data for the Jth joint. The joint identifying numbers (J) will be referred to by later input cards.

JOINT(J) An abbreviation of the nomenclature of the Jth joint (4 characters).

JS(J) Plot symbol of the joint location (1 character).

JNT(J) Magnitude indicates the number of the segment that is connected to segment J+1 by joint J. |JNT(J)| must be < J+1. Segment 1 is always the reference segment for the first body of segments. If more than one body is used, segment J+1 is defined as its reference segment by setting JNT(J)=0. This defines joint J as a null joint which does not link any segments.

If JNT(J)<0, joint J is associated with a flexible element (See B.7 cards).

Cards B.3.a (continued)

IPIN(J)
- 0 - there are to be no constraints on joint J.
- +1,-1 - joint J is a pin joint, with the pin as the y axis of the joint coordinate systems.
- +2,-2 - joint J is a ball and socket joint.
- +3,-3 - joint J is a globalgraphic joint.
- +4,-4 - joint J is an Euler joint.
- +5,-5,+6, -6,+7,-7 - joint is either an Euler joint or a slip joint depending on the input value of ISLIP as shown below.
- -8,-9,-10 - Euler joint.

A slip joint allows linear motion between the joint's segments along the z axis of the JNT(J) joint coordinate system. Its angular freedom is specified by a combination of IPIN and ISLIP as follows:

IPIN	ISLIP	
-5	0	Euler joint.
+5,-5	+1,-1	slip joint with complete angular freedom. Angular motion is the same as for IPIN = 2, about the J+1 joint coordinate system.
-6	0	Euler joint.
+6,-6	+1,-1	slip joint with pin as y axis of J+1 joint coordinate system. Angular motion same as for IPIN = 1. Flexural spring characteristics will be used.
-7	0	Euler joint.
+7,-7	+1,-1	slip joint with pin as the z axis of the joint coordinate systems. Torsional spring characteristics will be used.

Non-zero values for IPIN may be supplied as positive or negative to indicate that the initial condition of the joint is unlocked (positive) or locked (negative) for angular motion. An Euler joint may use the globalgraphic option by specifying IGLOB = 1 on Card F.4.a.

Cards B.3.a (continued)

An Euler joint can have any of its rotation axes locked or unlocked. This initial state is defined by IPIN and the program sets the value of IEULER based on the input value if IPIN as follows: !

IPIN	IEULER	state
4	8	free
- 4	7	all axes locked
- 5	6	spin free, others locked
- 6	5	nutation free, others locked
- 7	4	precession free, others locked
- 8	3	spin locked, others free
- 9	2	nutation locked, others free
-10	1	precession locked, others free

where precession, nutation and spin are the rotations from the JNT(J) joint coordinate system, to the J+1 joint coordinate system about the z axis, resultant x axis and resultant z axis respectively. !

SR(I,2*J-1),I=1,3 Coordinates of location of joint J (in.) in the local reference system of segment JNT(J).

SR(I,2*J),I=1,3 Coordinates of location of joint J (in.) in the local reference system of segment J+1.

ISLIP(J)
 1 - slip joint with unlocked linear motion.
 0 - non-slip joint.
 -1 - slip joint initially locked for linear motion.

Note: A slip joint may be locked or unlocked for angular motion (depending on the sign of IPIN) regardless of the sign of ISLIP.

C1(J) The maximum force (lbs.) (a negative value) allowed for a linearly locked joint in tension. If exceeded the joint will unlock.

C2(J) The maximum force (lbs.) (a positive value) allowed for a linearly locked joint in compression. If exceeded the joint will unlock.

Cards B.3.b FORMAT (14X, 9F6.0, 6I2) **

(One of these cards must follow each B.3.a card described above.)

YPR1(I,J),I=1,3	The rotation angles (degrees) about the z, y and x axes, respectively, of the local reference axes of segment No. JNT(J) to specify the axes of joint J. The sequence in which these rotations are made is specified by IDYPR below. The z axis defines the axis of linear slip for slip joints.
YPR2(I,J),I=1,3	The rotation angles (degrees) about the z, y and x axes, respectively, of the local reference axes of segment No. J+1 to specify the axes of joint J. The sequence in which these rotations are made is specified by IDYPR below. The z axis is the reference axis to define flexure. The y axis is used as the pin axis except for the special Euler joints. The x-y plane is used for globalgraphic joints with x as the reference axis.
YPR3(I,J),I=1,3	The center of symmetry (degrees) for Euler joints (used only if |IPIN(J)| = 4) supplied in the order precession, nutation and spin. Joint torques for Euler joints are a function of the deviation of the Euler angles from these angles. Previous versions (before 18a) of the program assumed values of zero.

Cards B.3.b (continued)

IDYPR(I,J),I=1,3 — The sequence in which the YPR1 rotations are made. Values of 1, 2 and 3 correspond to rotation angles about the x axis [YPR1(3,J)], y axis [YPR1(2,J)] and z axis [YPR1(1,J)] respectively. Zero or blank values will default to the order 3, 2 and 1 to specify the normal yaw, pitch and roll sequence, i.e.,

yaw about original z axis using YPR1(1,J),
pitch about resultant y axis using YPR1(2,J),
roll about resultant x axis using YPR1(3,J).

Two rotations about the same axis cannot be specified consecutively. However, the third rotation may be about the same axis as the first, provided it is supplied as a negative number, in which case the unused value of YPR1 will be used about the indicated axis, e.g., values of 3, 1 and -3 will specify the normal Euler rotations where YPR1 is supplied in the order precession, spin and nutation to compute:

precession (YPR1(1,J)) about original z axis,
nutation (YPR1(3,J)) about resultant x axis,
and spin (YPR1(2,J)) about resultant z axis.

IDYPR(I,J),I=4,6 — The sequence in which the YPR2 rotations are made. Identical to the description of IDYPR(I,J), I=1,3.

Cards B.4 FORMAT (2 (4F6.0, F12.0))

(NJNT sets of cards, one set for each joint J. If joint J is not an Euler joint, the set has one card containing the values for 3*J-2 and 3*J-1. If joint J is an Euler joint, the set has two cards with the second card containing the values for 3*J.)

SPRING(I,3*J-2), I=1,5	The flexural spring characteristics for joint J. If J is an Euler joint, the spring characteristics about the precession axis. If JOINTF(J) # 0 (on Card F.5), these values are not used and should be zero.
SPRING(I,3*J-1), I=1,5	The torsional spring characteristics for joint J. If J is an Euler joint, the spring characteristics about the nutation axis.
SPRING(I,3*J), I=1,5	The spring characteristics about the spin axis. This second card of each set is required only if J is an Euler joint.
I=1	Linear spring coefficient (in-lbs/deg).
I=2	Quadratic spring coefficient (in-lbs/deg**2).
I=3	Cubic spring coefficient (in-lbs/deg**3).
I=4	Energy dissipation coefficient (dimensionless variable between 0 and 1). A value of 1. specifies no loss. A value of 0. specifies maximum loss.
I=5	Joint stop location with respect to the center of symmetry (deg). For a value of zero the routine will use only the linear spring coefficient and will apply the energy dissipation coefficient.
ANG(I,J),I=1,3	The approximate initial rotation angles, in the order precession, nutation and spin, (degrees) for joint J which is an Euler joint. These are used as the initial angles for the memory mode used by Subroutine EULRAD and need not be exact. The values are absolute and not relative to the center of symmetry.

Cards B.5 FORMAT (5F6.0, 18X, 2F6.0)

(NJNT sets of cards, one set for each joint J. If joint J is not an Euler joint, the set has one card containing the values for 3*J-2. If J is an Euler joint, the set has three cards with the values for 3*J-1 on the second card and for 3*J on the third.)

VISC(I,3*J-2), I=1,7 — The viscous characteristics for joint J. If J is an Euler joint, the viscous characteristics about the precession axis.

VISC(I,3*J-1), I=1,7 — The second card of each set is required only if J is an Euler joint. The viscous characteristics about the nutation axis.

VISC(I,3*J) I=1,7 — The third card of each set is required only if J is an Euler joint. The viscous characteristics about the spin axis.

I=1 — Viscous coefficient (in-lb-sec/deg).

I=2 — Coulomb friction coefficient (in-lb).

I=3 — Relative angular velocity of the joint at which full coulomb friction is applied (deg/sec). Must be greater than 0.

I=4 — T1: The maximum torque (in-lbs) allowed for a locked joint (or locked Euler axisu. If exceeded, the joint will unlock. If T1 = 0, the test will not be performed and a locked joint will remain locked. Note: If joint J is locked and T1=0, when the equilibrium option is used, VISC(4,3*J-2) will be set by the program (See equilibrium option description under Cards G.6).

I=5 — T2: The minimum torque (in-lbs) allowed for joint J to remain unlocked. If T2 = 0, the test will not be performed.

I=6 — T3: The minimum angular velocity (rad/sec) necessary for joint J to remain unlocked. If T3 = 0, the test will not be performed.

Cards B.5 (continued)

I=7 — E: Where $E=(1+U)/2$ and U is the classical coefficient of restitution to be used for the impulse option if the joint hits the joint stop ($0<E<1$ OR $-1<U<+1$). A value of $E = 0$ means that the impulse option will not be exercised for this joint.

Cards B.6 (NSEG cards) FORMAT (12F6.0)

The following cards are required for the convergence tests which are performed in Subroutine DINT on the resultant of the derivative vectors. The linear velocities and accelerations are computed only for reference segments (i.e. segment No. 1 and those segments I where JNT(I-1) = 0), therefore any test numbers supplied for linear velocities and accelerations of other segments will be ignored. The tests for convergence are performed in the following order:

1) If the magnitude value is zero, no testing is done for that variable.

2) If the magnitude of the resultant vector is less than the specified magnitude value, the routine has passed the convergence test for that variable.

3) If the absolute error value is greater than zero, and the magnitude of the absolute error (difference between the predicted and computed vector) is less than the absolute error value, the routine has passed the convergence test for that variable.

4) If the relative error value is greater than zero and the magnitude of the absolute error divided by the magnitude of the computed vector is less than the relative error value, the routine has passed the convergence test for that variable.

SGTEST(1,1,I)	Magnitude value for the angular velocity test of segment No. I (rad/sec).
SGTEST(2,1,I)	Absolute error value for the angular velocity test of segment No. I (rad/sec).
SGTEST(3,1,I)	Relative error value for the angular velocity test of segment No. I (dimensionless).
SGTEST(J,2,I), J=1,3	Same as above, but for the linear velocity of segment No. I (in/sec).
SGTEST(J,3,I), J=1,3	Same as above, but for the angular acceleration of segment No. I (rad/sec**2).
SGTEST(J,4,I), J=1,3	Same as above but for the linear acceleration of segment No. I (in/sec**2).

If JNT(J)<0 on any of the B.3 cards, Cards B.7 are required.

Card B.7.a FORMAT (18I4)

Each flexible element must contain at least three connected segments. The first segment is the reference segment, followed by one or more interior segments and a terminating segment. Each joint in the flexible element must have a negative value for JNT.

NFX	The total number of interior segments for all the flexible elements.
KNT(K),K=1,NFX	The interior segment identification numbers in the order specified on the B.3 cards. If the values of NFX and KNT are not consistent with the negative values of JNT on Cards B.3, the program will terminate with an appropriate error message.

Cards B.7.b FORMAT (12F6.0)

(Four B.7.b cards for each interior segment (4*NFX) are required, in the order as they are defined in the KNT vector.)

(HF(I,J,K),J=1,12) ,I=1,4	The coefficients of the quadratic form function used to define the orientation of interior segment KNT(K) with respect to the reference segment of the element.

HF contains three 4X4 matrices; HF(I,J,K), HF(I,J+4,K) and HF(I,J+8,K), where I=1,4 and J=1,4. These matrices are used to define the orientation of segment KNT(K) with respect to its reference segment as follows:

```
  yaw of segment KNT(K) = 1/2 V.HF(I,J  ,K)V;
pitch of segment KNT(K) = 1/2 V.HF(I,J+4,K)V;
 roll of segment KNT(K) = 1/2 V.HF(I,J+8,K)V;
                                   (I,J=1,4).
```

Where V is a column vector with four components y, p, r and 1, and y, p, r are the yaw, pitch and roll angles in radians of the terminating segment relative to the reference segment. V.HFV represents the dot product between vectors V and HFV. Note: The pitch is always > -90 degrees and < 90 degrees.

C. Subroutine VINPUT

The C cards are used to prescribe the motion of specified segments. A set of C cards is required for each prescribed motion. At least one set of C cards is required and a maximum of six sets is allowed. If a set of C cards does not prescribe the motion of one of the segments defined in the B cards, then an independent vehicle segment is automatically defined. The last set of C cards always defines the primary vehicle. This vehicle is used as a default for a number of outputs. The other vehicles are designated as secondary vehicles.

Several options are available for each prescribed motion. The required inputs for each option are as follows:

Option 1: Half sine wave deceleration impulse (NATAB = 0)

Required inputs - Card C.1: all variables,
Card C.2.a: ANGLE(1), ANGLE(2), VIPS, VTIME, X0, NATAB=0, MSEG.

Option 2: Tabular unidirectional deceleration (NATAB > 0)

Required inputs - Card C.1: all variables,
Card C.2.a: ANGLE(1), ANGLE(2), VIPS, X0, NATAB>0, AT0, ADT, MSEG,
Cards C.3: all variables.

Option 3: Six degree of freedom deceleration (NATAB < 0 and LTYPE = 0)

Required inputs - Card C.1: all variables,
Card C.2.a: ANGLE(1), ANGLE(2), ANGLE(3), VIPS, X0, NATAB<0, AT0, ADT, MSEG,
Card C.2.b: LTYPE=0, VMEG,
Cards C.4: all variables.

Option 4: Spline fit position, velocity or acceleration data (NATAB <0 and LTYPE > 0)

Required inputs - Card C.1: all variables,
Card C.2.a: NATAB<0, AT0, ADT, MSEG,
Card C.2.b; LTYPE>0, LFIT, NPTS,
Cards C.5: all variables.

C Cards (continued)

These options and their required inputs have been established in such a manner that any previous input decks are still acceptable as input, except that Card C.2.b was added for option 3 for Version 18 of the ATB program. For Version 19, Card C.2.b was modified and option 4 (Cards C.5 and the multiple prescribed motion) were added.

Card C.1	FORMAT (20A4) **
VPSTTL	Description of the crash vehicle deceleration (80 characters).

Card C.2.a FORMAT (8F6.0, I6, 2F6.0, I6)

ANGLE(I),I=1,3	Options 1 and 2: ANGLE(1) and ANGLE(2) (deg) are the azimuth and elevation angles of the deceleration impulse vector, from the inertial coordinate system. The initial orientation of the vehicle is assumed to be aligned with the inertial coordinate system. Option 3: The three initial rotation angles, yaw, pitch and roll (deg), of the prescribed motion segment.
VIPS	Options 1, 2 and 3: The initial velocity (in/sec) of the prescribed motion segment. For option 1, a negative value may be supplied to indicate that the vehicle will accelerate from an initial velocity of zero to VIPS, the final velocity.
VTIME	Option 1: The time duration (sec) of the half sine wave deceleration impulse. It must not be zero or blank for option 1.
XO(I),I=1,3	Options 1, 2 and 3: The x, y and z coordinates (in) of the vehicle reference origin in inertial reference.
NATAB	Number of time points of vehicle deceleration data to be supplied or generated by the program. The algebraic sign of NATAB determines the option of prescribed motion as follows: If NATAB = 0 (option 1), the prescribed motion is an analytical half sine wave function that decelerates the vehicle from an initial velocity of VIPS to ZERO if VIPS>0. If VIPS<0, the vehicle is accelerated from an initial velocity of zero to VIPS final velocity in VTIME sec.

Card C.2.a (cont.)

If NATAB > 0 (option 2), the vehicle motion is unidirectional and NATAB values of linear deceleration are to be supplied on Cards C.3. NATAB should be odd, maximum value is 99.

If NATAB < 0 (options 3 and 4), the prescribed motion is specified on either Cards C.4 or C.5. Here MATAB = -NATAB is the number of time points of acceleration data to be supplied on Card C.4 or computed from the spline fit data on Cards C.5, maximum value of MATAB is 501.

ATO,ATD — The first time point and fixed time interval (sec) for the table of acceleration data that is supplied on Cards C.3 for option 2, on Cards C.4 for option 3 or for option 4, is to be computed from the spline fit data to be supplied on Cards C.5. The program initially calculates the vehicle acceleration time histories from the provided tabular data and integrates these accelerations to specify the vehicle motion during the simulation.

MSEG — The segment number associated with this prescribed deceleration time history. If MSEG is less than or equal to NSEG (Card B.1), the motion of segment No. MSEG as defined on Cards B.2 will be prescribed (note: extreme caution must be exercised in using this option.) If MSEG > NSEG, the sets must be supplied in the order MSEG=NSEG+1, NSEG+2, etc., to prescribe the motion of secondary vehicle segments. The program assigns the segment number MSEG to the corresponding secondary vehicle. The last set of C cards must contain the prescribed motion for the primary vehicle and MSEG must be zero. (This signals the end of the C card input.) The program assigns the segment number NSEG + the number of secondary vehicles + 1 to the primary vehicle. The primary vehicle segment number can not be greater than 29.

Card C.2.b FORMAT (3I6, 22X, 3F10.0)

This card is required only if NATAB < 0 (options 3 and 4). Note: This card was added for Version 18 of the ATB program to supply the initial angular velocity and was revised for Version 19. A blank card should be inserted here for any previous input data decks that utilized the six degree of freedom option on Cards C.4.

LTYPE

Option 3: A value of zero or blank specifies the six degree of freedom option with required input on Cards C.4.

Option 4: The value of LTYPE specifies the type of data contained in the C.5 cards.

If LTYPE=1, the C.5 input table is position data.

If LTYPE=2, the first C.5 card is the initial position data, which is followed by the input table of velocity data.

If LTYPE=3, the first C.5 card is the initial position data, the second card is the initial velocity data, which is followed by the input table of acceleration data.

LFIT

Option 4: The degree of the polynomials to be spline fitted through the time point data on Cards D.5. A value of 0, 1, 2 or 3 may be used but the degree should be sufficient to produce continuity for the computed velocity values. Therefore:

For LTYPE = 1, supply LFIT= 2 or 3.
For LTYPE = 2, supply LFIT= 1, 2 or 3.
For LTYPE = 3, supply LFIT= 0, 1, 2 or 3.

Note if LFIT = 0, a constant value is assumed from the current time value to the next time value but round off errors in time computations may not produce the time desired.

Card C.2.b (continued)

NPTS	The number of actual time point data to be supplied on Cards C.5, maximum value is 101. Note: The number of C.5 cards must be equal to (LTYPE -1) + NPTS, where the (LTYPE -1) cards are the initial position and/or initial velocity data.
VMEG(I),I=1,3	The three components of the initial angular velocity (deg/sec) about the local x, y and z axes of the vehicle. Not required if the spline fit (option 4) is to be used.

Cards C.3 FORMAT (12F6.0)

These cards are required only if NATAB > 0 (option 2).

DEC(I),I=1,NATAB — The values of deceleration (G's) of the vehicle for the NATAB equally spaced time points as T(I), where:

T(I) = ATO + (I-1)*ADT for I=1,NATAB.

Supply 12 values per card, use as many cards as necessary. Since a Simpson's integration is used to compute velocity and position, the value of NATAB must be odd. The program will integrate beyond the last time point assuming a constant deceleration equal to the value of the last given point.

Cards C.4 FORMAT (10X, 6F10.0)

These cards are required if NATAB<0 and LTYPE=0 (option 3).

MATAB C.4 cards are required where MATAB = -NATAB. Each card (I) will contain data for equally spaced time points T(I), where:

T(I) = ATO + (I-1)*ADT for I=1,MATAB.

ATAB(J,I),J=1,3 — The x, y and z components (g's) of the linear deceleration of the vehicle origin at time T(I).

ATAB(J,I),J=4,6 — The angular accelerations (deg/sec**2) about the local x, y and z axes of the vehicle at T(I).

Note: The program will integrate for velocity and position beyond the last time point, assuming a constant acceleration equal to the value of the last given point. The program will print at input time a complete table of the integrated velocity and position from the supplied acceleration data. This integration procedure is not identical to the program integrator.

These cards are required if NATAB<0 and LTYPE>0 (option 4).

(LTYPE-1) cards are required first to set initial conditions followed by NPTS cards containing time point data.

If LTYPE=1, the input table is position data for NPTS time points.

If LTYPE=2, the first card is the initial position data, which is followed by the input table of velocity data for NPTS time points.

If LTYPE=3, the first card is the initial position data, the second card is the initial velocity data, which is followed by the input table of acceleration data for NPTS time points.

T(I)	The time (sec) for the data on this card. If this card is for initial condition data, T(1) should be zero or blank. The times should be in ascending order but do not have to be equally spaced.
XYZ(J,I),J=1,3	If position data, the x, y and z coordinates (in) of the vehicle origin in the inertial reference coordinate system for time T(I). If velocity data, the x, y and z components (in/sec) of velocity of the vehicle origin in the inertial reference for time T(I). If acceleration data, the x, y and z components (G's) of the deceleration of the vehicle origin in inertial reference for time T(I).
XYZ(J,I),J=4,6	If position data, the yaw, pitch and roll (deg) of the vehicle coordinate reference axes with respect to the inertial reference. If velocity data, the components of angular velocity (deg/sec) about the local x, y, z axes. If acceleration data, the components of angular acceleration (deg/sec**2) about the local x, y and z axes.

Cards C.5 (continued)

Note: When LTYPE = 2 or 3, the program will spline fit the NPTS data points for each of the six components independently. For LTYPE = 1, the angular displacements are transformed to quaternions and the four quaternion components and the three linear components are spline fit independently. The quaternions are then transformed back to yaw, pitch, and roll angles. The spline fit produces a piece-wise set of polynomials of degree LFIT. These polynomials are then evaluated to produce a set of acceleration tables at MATAB equally spaced time points equivalent to the six degree of freedom (option 3) data of Cards C.4. The program will then print at input time a complete table of the integrated velocities and positions from these generated acceleration data. The integration procedure used is not identical to the program integrator. The spline fit algorithm used in the program can be used to calculate angular accelerations from simultaneous multi-axis angular displacements.

D. Subroutine SIMPUT

Card D.1 *FORMAT (10I6)*

NPL	The number of planes describing contact panels (30 maximum).
NBLT	The number of belts used to restrain the crash victim (8 maximum).
NBAG	The number of airbags used to restrain the crash victim on Cards D.4 (max = 5, but NSEG + the number of vehicles + NBAG must be < 30).
NELP	The number of contact ellipsoids or hyperellipsoids to be supplied on Cards D.5 (40 maximum).
NQ	The number of constraints to be supplied on Cards D.6. Each constraint, with KQTYPE(J) = 5 on Cards D.6, will be considered as two constraints requiring two sets of cards. (Note: The program will later increment NQ by 1 for each NF(1) = 0 on Cards F.1.b and F.3.b. Final maximum on NQ is 12).
NSD	The number of spring dampers to be supplied on Cards D.8 (20 maximum).
NHRNSS	Number of harness-belt systems to be supplied on Cards F.8, may be zero or blank. Maximum value = 5.
NWINDF	The number of wind force and drag coefficient functions to be supplied on Cards E.6, may be zero or blank. The maximum = 50 if no other force functions are supplied.
NJNTF	The number of joint restoring force functions to be supplied on Cards E.7, may be blank or zero. The maximum = 50 if no other force functions are supplied.
NFORCE	The number of force and/or torque functions to be supplied on Cards D.9 (maximum = 5).

If NPL is nonzero on Card D.1, NPL sets of Cards D.2 are required.

Card D.2.a	FORMAT (I4, 4X, 5A4)
J	The plane identification number, must be supplied as consecutive integers from 1 to NPL.
PLTTL	A 20 character description of the Jth panel.

Cards D.2.b - D.2.d	FORMAT (3F12.0)
P1(I),I=1,3	The x, y and z coordinates of point P1 in vehicle (or segment to which the plane is attached) reference (in).
P2(I),I=1,3	The x, y and z coordinates of point P2 in vehicle (or segment to which the plane is attached) reference (in).
P3(I),I=1,3	The x, y and z coordinates of point P3 in vehicle (or segment to which the plane is attached) reference (in).

Where P1, P2 and P3 are three of the corners of a parallelogram such that the edge P1P2 is less than 180 degrees clockwise (as viewed from the external surface) from the edge P1P3. Note: Any previous input deck in which the vector P1P2 is not perpendicular to the vector P1P3 will now produce different results.

Note: The positive side of the plane is defined by crossing the edge vector, P1P2, into the edge vector, P1P3. Contact with a plane must occur with the positive side.

If NBLT is nonzero on Card D.1, NBLT sets of Cards D.3 are required.

Card D.3.a	FORMAT (5A4)
BLTTTL	A 20 character description of the Jth belt.
Card D.3.b	FORMAT (6F12.0)
BELT(I,J),I=1,3	The x, y, and z coordinates, in vehicle (or segment to which belt is anchored) reference, of anchor point A for the Jth belt (in).
BELT(I,J),I=4,6	The x, y, and z coordinates, in vehicle (or segment to which belt is anchored) reference, of anchor point B for the Jth belt (in).

Note: The program must pass a plane through the three points: The anchor point A, the anchor point B and a fixed point on the contacted body segment. If anchor points A and B coincide, they must be separated slightly such that the desired belt plane will be defined. Also, the anchor points must be located such that they are not allowed to penetrate the contact ellipsoid to which the belt is attached.

Card D.3.c FORMAT (5F12.0)

BELT(I,J),I=7,9	The x, y, and z coordinates, in the contact ellipsoid reference (not the local reference system of the segment), of the fixed contact point on the body segment for the Jth belt (in).
BELT(10,J)	Currently not used by the program.
BELT(11,J)	Belt slack (in). If BELT(11,J) is zero or positive, the initial belt length with slack is defined by adding the belt slack to the initial geometric length, calculated from the placement of the belt points. If BELT(11,J) is negative and its magnitude is less than the initial geometric length, the geometric length is defined as the initial belt length with no slack. If BELT(11,J) is negative and its magnitude is greater than the geometric length, the value supplied will be defined as the initial belt lenth with slack. Note that the belts do not allow pretensioning.

If NBAG is nonzero on Card D.1, NBAG sets of Cards D.4 are required by Subroutine AIRBG1. Note: All references to the vehicle refer to the primary vehicle, segment No. NVEH (NSEG + the number of vehicles supplied in the C cards.

Card D.4.a	FORMAT (5A4, I4)
BAGTTL	A 20 character description of the Jth air bag.
NPANEL(J)	Number of vehicle contact panels that are allowed to interact with the Jth air bag (maximum = 4).

Card D.4.b	FORMAT (6F12.0)
AB(I,J),I=1,3	The x, y and z semiaxes of the Jth air bag when fully inflated and undeformed (in).
BFA(I,J),I=1,3	The x, y and z coordinates of the center of the air bag contact ellipsoid with respect to the air bag center-of-mass (in).

Card D.4.c	FORMAT (6F12.0)
YB,PB,RB	The initial orientation (yaw, pitch, and roll) of the Jth air bag in the vehicle reference (deg).
ZDEP(I,J),I=1,3	The x, y, and z coordinates of the deployment point of the Jth air bag in the local reference of the 1st panel on Cards D.4.g and h (in).

Card D.4.d	FORMAT (6F12.0)
XBM(J)	Weight of air bag membrane ana contents (lbs).
CYTD(J)	Gas supply actuator firing time after the start of vehicle deceleration (sec).
CYPA(J)	Atmospheric pressure (psia).
CYSP(J)	Initial gas supply pressure (psig).
CYTO(J)	Initial gas supply temperature (deg R).
CYVO(J)	Gas supply reservoir volume (in**3).

Card D.4.e	FORMAT (6F12.0)
CYCD(J)	Sonic throat discharge coefficient (dimensionless).
CYK(J)	Ratio of specific heats of supply gas (dimensionless).
CYR(J)	Specific gas constant (in/deg R).
CYAT(J)	Sonic throat area (in**2).
CYPV(J)	Vent pressure of the exhaust orifice (psig).
CYCDO(J)	Exhaust orifice discharge coefficient (dimensionless).

Card D.4.f FORMAT (5F12.0)

CYA0(J)	Exhaust orifice area (in**2).
SPRK(J)	Spring constant of a linear spring used to simulate attachment of the bag at the deployment point in the vehicle (lb/in).
VSCS(J)	Coefficient of sliding friction of the air bag (dimensionless).
CK(J)	Parameter used to stabilize air bag numerical integration (sec**-1). Suggested value = 250.
CMASS(J)	Multiplier to increase or decrease the mass of the air bag to artificially dampen the integrated air bag motion.

NPANEL(J) sets of the following two cards are required to define the ellipsoids used to approximate the contact panels for the Jth air bag. The first panel is the reaction panel.

Card D.4.g FORMAT (6F12.0)

B(I,K,J),I=1,3	The x, y, and z semiaxes for the Kth panel for the Jth air bag (in).
BFB(I,K,J),I=1,3	The location of the center of the panel ellipsoid with respect to its center-of-mass (in).

Card D.4.h FORMAT (6F12.0)

ZR(I,K,J),I=1,3	The x, y, and z coordinates in vehicle reference of the center-of-mass of the Kth panel of the Jth air bag (in).
YP,PP,RP	Angular orientation; yaw, pitch and roll (deg.), of the Kth panel with respect to the vehicle.

If NELP is nonzero on Card D.1, NELP D.5 Cards are required.

Note: NELP is the number of contact ellipsoids and hyperellipsoids to be supplied here, not the total number of contact ellipsoids in the program. The first NSEG ellipsoids were supplied on Cards B.2. They may be replaced here and additional (hyper)ellipsoids may be added.

Cards D.5 (NELP Cards)	FORMAT (I6, 9F6.0,3F4.0)
M	Contact (hyper)ellipsoid number, maximum is 40. If M < NSEG + 1, data will replace input supplied on Cards B.2. If M is equal to a vehicle or the ground segment number, it is associated with that segment. Otherwise, M must be greater than NSEG + the number of vehicles + NBAG + 1.
P1(I),I=1,3	The x, y, and z semiaxes of the contact (hyper)ellipsoid (in).
P2(I),I=1,3	The x, y, and z coordinates of the (hyper)ellipsoid offset from the segment center-of-mass.
P3(I),I=1,3	The yaw, pitch and roll (degrees) of the contact (hyper)ellipsoid from the local reference axis of the segment.
P4(I),I=1,3	The powers of the (hyper)ellipsoid. I.e. the values of Ni in the (hyper)ellipsoid functional; (x/a)**N1 + (y/b)**N2 + (z/c)**N3. Values must be even integers. If all P4 are less than or equal to 2 the surface will be treated as an ellipsoid. If P4(1)>0 and P4(2) or P4(3) are zero, the zero value(s) will be set to P4(1), i.e. only P4(1) needs to be entered for all equal powers. Note: Hyperellipsoids may not be used with the belt, airbag, harness belt or wind routines, or with the roll-slide options for plane-segment or segment-segment contact. Also different powers can only be used for plane-segment contacts without the edge-effect option.

If NQ is nonzero on Card D.1, NQ D.6 Cards are required.

Cards D.6 (NQ Cards) FORMAT (3I6, 6F6.0)

KQTYPE(J)	Type No. of the Jth constraint 1: Point specified by RK1 on segment KQ1 will be constrained to be the same as the point specified by RK2 on segment KQ2. 2: Point specified by RK1 on segment KQ1 will be constrained to remain at an equal distance, D, (where D > 0) from the point specified by RK2 on segment KQ2. 5: Tension element constraint connecting point RK1 on segment KQ1 to point RK2 on segment KQ2 (requires two cards with the same KQTYPE, KQ1 and KQ2 on both).
KQ1(J)	Segment identification number of the 1st specified point.
KQ2(J)	Segment identification number of the 2nd specified point.
RK1(I,J),I=1,3	Coordinates of specified point in the local coordinate system of segment KQ1 (in). If KQTYPE = 5, the second card will contain the effective masses MA, MB and MAB (lb.sec**2/in) in place of RK1.
RK2(I,J),I=1,3	Coordinates of specified point in the local coordinate system of segment KQ2 (in). If KQTYPE = 5, the second card will contain the spring constant K (lb/in), the viscous damping constant D (lb sec/in) and the reference length L (in) in place of RK2. Note: If KQTYPE = 1 and KQ2 is the number for the vehicle, then Subroutine EQUILB will modify these values of RK2 such that they will be equivalent to RK1 in inertial reference for time zero (see description under Cards G.6.).

Card D.7 is always required. Supply blank card for normal 3D motion.

Card D.7	FORMAT (18I4)	If NSEG>18, use 2 cards.

NSYM(J),J=1,NSEG	Controls symmetry option of body segments as follows :
NSYM(J) = 0 :	Normal three-dimensional motion for body segment J.
NSYM(J) = J :	Motion of body segment J will be restricted to a x-z plane parallel to the inertial x-z plane with no lateral motion, hence it will be two-dimensional.
NSYM(J) = K :	Body segments J and K are to remain symmetrical with no lateral motion. The motion of each will be replaced with their average and restricted to a x-z plane parallel to the inertial x-z plane. NSYM(K) must equal J.
NSYM(J) = -K :	Body segments J and K are to remain mirror symmetrical with respect to a x-z plane parallel to the inertial x-z plane. Equal but opposite lateral motion is permitted. NSYM(K) must equal -J.

Note: In the above symmetry options, the user must take extreme care that all input will allow the symmetry to exist.

If NSD is nonzero on Card D.1, NSD D.8 Cards are required.

Cards D.8 (NSD cards)	FORMAT (2I3, 11F6.0)
MSDM(J) MSDN(J)	Segment identification numbers (M and N) to which the Jth spring damper is attached.
APSDM(I,J),I=1,3 APSDN(I,J),I=1,3	Coordinates of attachment points in local segment reference on segments M and N for the Jth spring damper (in.).
ASD(I,J),I=1,5	Coefficients of quadratic functions.

I=1 : D0 (in)
I=2 : A1 (lb/in) or integer
I=3 : A2 (lb/in**2)
I=4 : B1 (lb sec/in) or integer
I=5 : B2 (lb sec**2/in**2)

The quadratic functions used to compute the spring force (FS) and the viscous force (FD) for the Jth spring damper are defined by the following relations:

```
FS= (D-D0)*(|A1| + A2*|D-D0|)
FD=      DV*( B1  + B2*|DV|)
```

where D and DV are the distance and its time derivative between the points APSDM and APSDN.

The following options are available:

(1) If A1<0, this will act strictly as a tension element and the program will set FS=0 and FD=0 for (D-D0)<0.

(2) If D0<0 and A2=0 or (D-|D0|)<0

a. If A1=0, program will set FS=0.
If A1#0, A1 will be a function number (a positive real integer) to indicate that FD will be evaluated as a function of (D-|D0|) using function No. A1 defined on Cards E.

b. If B1=0, program will set FD=0.
If B1#0, FD will be computed as FS above by function No. B1.

If NFORCE is nonzero on Card D.1, NFORCE D.9 Cards are required.

Cards D.9 (NFORCE cards) FORMAT (2I6, 6F10.0)

NFVSEG(J)	The identification number of the segment to which the Jth force function is to be applied. If NFVSEG(J) is negative, a time-dependent torque will be applied to the segment instead of a force.
NFVNT(J)	The identification number of the function on Cards E that defines the force (lbs) or torque (in-lbs) as a function of time (sec).
X,Y,Z	The coordinates (in) of the point in the local reference of segment NFVSEG at which the force or torque is to be applied.
Y,P,R	The yaw, pitch and roll (degrees) of the force coordinate system with respect to the local reference of segment NFVSEG. The force is applied in the direction of the positive x axis of this force reference system. The force coordinate system is initially aligned with the segment local reference system. If a torque is to be applied, it will be applied about the x axis of the force coordinate system, where a positive torque is in a counterclock-wise direction looking down the positive x axis towards the origin.

E. Subroutine CINPUT (functions input)

The functions defined by the E.1 through E.4 cards are referred to by number in the NF arrays required on Cards F.1.b, F.2.b, F.3.b, F.4.b, F.8.c and F.8.d1, and by other variables on Cards D.8 and D.9. They are used to define the force deflection, inertial spike, R (energy absorption) factor, G (permanent deflection) factor, friction coefficient, rate dependent, stress/strain and other functions.

Each function may be subdivided, if desired, into two separate parts, F1 and F2, where

F1(D) is defined for 0 .LE. D0 .LE. D .LE. ¦D1¦

F2(D) is defined for ¦D1¦ .LE. D .LE. ¦D2¦.

In addition, each part of a function may be defined by either of three functional forms: constant value, tabular data or a fifth degree polynomial. The existence and form of each part is determined by the supplied values of D0, D1 and D2 as follows:

F1	F2	D0	D1	D2
Constant	-	0	0	D2 = F1
Tabular	-	D0	D1 .LT. 0	0
Polynomial	-	D0	D1 .GT. 0	0
Tabular	Polynomial	D0	D1 .LT. 0	D2 .GT. 0
Polynomial	Tabular	D0	D1 .GT. 0	D2 .LT. 0
Polynomial	Polynomial	D0	D1 .GT. 0	D2 .GT. 0

The routines assume:

If D.GT.¦D2¦ then F(D) = F(¦D2¦) for D2.NE.0.

If D.GT.¦D1¦ then F(D) = F(¦D1¦) for D2 = 0.

If D.LT.D0 then F(D) = F(D0).

The case of both F1 and F2 being tabular is unnecessary.

A maximum of 50 functions may be supplied to the program. These functions may be of the types described on Cards E.1-E.4, Cards E.6 or Cards E.7.

Card E.1	FORMAT (I4, 4X, 5A4)
I	The function identifying number. These numbers need not be supplied in numeric order. If the same number is used more than once, a warning will be printed and the last one supplied will be used. The end of the function input is indicated by supplying a single card with I > 50.
KTITLE	A 20 character alphanumeric title describing the function.

Card E.2 FORMAT (5F12.0)

D0

The lower abscissa value of the first part (F1) of the function. Units are dependent on usage of the function, i.e. in. for deflection, in./in. for stress-strain, in/sec for rate dependent functions. Normally a value of zero is used for force deflection functions. A negative value may be supplied for rate dependent functions.

D1

The magnitude of D1 is the upper abscissa value of F1 and the lower abscissa value of F2, if any. D1 < 0 indicates F1 is tabular, D1 > 0 indicates F1 is a polynomial, and D1 = 0 indicates F1 = D2, a constant.

D2

If D1 = 0, D2 is the constant value of F1. Otherwise, the magnitude of D2 is the upper abscissa value of F2. If D2 = 0, F2 is not defined; if D2 is negative, F2 is tabular; and if D2 is positive, F2 is a polynomial.

D3

If the function is to be used for an inertial spike, D3 represents the abscissa value for which the inertial spike is to be ignored if unloading occurs after deflection exceeds D3.

If the function is to be used for a coefficient of friction, a value of D3 = 0 means that the impulse option will not be used for those contacts using this function. If the impulse option is used, D3 = (1+U)/2 and U is the classical coefficient of restitution for the impulse option ($0<D3<1$ or $-1<U<+1$).

If the function is to be used for a coefficient of friction for a globalgraphic joint, the value of D3 is used to specify the impulse. (See Card B.5.)

Card E.2 (continued)

D4

If the function is to be used as a force deflection function for plane-segment contact D4, is a scalar that determines the point of contact force application. The point of application can be anywhere along a line between the point of maximum penetration and the center of the intersection area. Supply zero for the point of maximum penetration and one for the center of the intersection area ($0<D4<1$).

If used as the friction function for a roll-slide constraint, D4 is the coefficient of static friction to be used for the roll constraint.

If F1 is a polynomial, an E.3 card is required. If F1 is tabular data, a set of E.4 cards is required. If F2 exists, an E.3 card, for a polynomial F2, or a set of E.4 cards, for a tabular F2, follows the cards defining F1.

Card E.3	FORMAT (6F12.0)
A0,A1,A2,A3,A4,A5	Coefficients of a fifth-degree polynomial F = A0 + A1*X + A2*X**2 + A3*X**3 + A4*X**4 + A5*X**5 (Units are dependent on use of the function)

Card E.4.a	FORMAT (I6)
NPI	The number of data points to be supplied to identify the function if it is defined in tabular form.

Cards E.4.b	FORMAT (6F12.0)
(X(I),Y(I),I=1,NPI)	The abscissa and ordinate values of the data points used to define the tabular form of the function. The program will linearly interpolate to determine intermediate values. Supply 3 points per card; use as many cards as required. Note: Abscissa values must be supplied in ascending order, starting with the lower abscissa value, D0 or D1, and ending with the upper abscissa value, D1 or D2. (Units are dependent on use of the function.)

Note: Always supply a Card E.1 with a function number > 50 after all functions are defined to signal the end of the function inputs.

Subroutine KINPUT (wind force and joint restoring force functions)

If NWINDF=0 on Card D.1, Cards E.6 are not required. Otherwise, NWINDF sets of Cards E.6.a - E.6.d are required.

Note: There are now two types of wind force functions. The first is the time dependent wind force function that was in previous versions. The coordinate system that the components of the wind force pressure vector are specified in can now be selected for this option (it was previously the ground). The recently added second type of wind force function computes the wind force as a function of the relative velocity of a segment. It is based on inviscid, subsonic compressible flow theory for a fluid in which the segments are completely immersed. Also, there is now the option of using a time dependent drag coefficient of the form: F = CD*P where P is the wind force pressure computed either by the time dependent wind force option or by the relative velocity wind force option, CD is the time dependent drag coefficient and F is the wind force on a segment.

Card E.6.a FORMAT (I4, 4X, 5A4)

I,KTITLE Same as Card E.1. Each function number (I) must be less than 51 and must be distinct from those supplied on Cards E.1.

Note: Previous versions required a blank Card E.6.b. If the time dependent wind force or drag coefficient option is selected a blank Card E.6.b is required unless the orientation of the wind forces, FX, FY and FZ supplied on Cards E.6.d, are with respect to a segment other than the ground. In this case the reference segment identification number (D4) must be supplied, with all other Card E.6.b parameters not required. If the velocity dependent wind force option is selected, the following parameters must be supplied.

Card E.6.b FORMAT (3F12.0,2I12)

D0 Ratio of specific heats of the compressible fluid in which the segments are immersed. Required when the wind force is calculated as a function of velocity. For time dependent wind force functions and drag coefficient functions must be zero or blank. (Dimensionless)

D1 Speed of sound of the compressible fluid in which the segments are immersed (in./sec.). Required when the wind force is calculated as a function of velocity. Not used by time dependent wind force or drag coefficient functions.

D2 Absolute pressure of the fluid in which the segments are immersed (lbs./in.**2). Note that it is assumed constant, i.e. the change in altitude of the segment is assumed to be small. Required when the wind force is calculated as a function of velocity. Not used by time dependent wind force or drag coefficient functions.

D3 Identification number of the segment whose velocity relative to reference segment D4 is used to compute the velocity dependent wind force. Required when the wind force is calculated as a function of velocity. Not used by time dependent wind force or drag coefficient functions.

D4 Reference segment identification number for the coordinate system that D3's velocity will be relative to if a velocity dependent wind force is selected. For time dependent wind force functions, it is the reference segment number whose coordinate system the components of the wind force, FX, FY, and FZ (from Cards E.6.d-n) are with respect to. If zero or blank, default will be the ground. Not used by drag coefficient functions.

Not required for velocity dependent wind force functions (DO ≠ 0 on Card E.6.b).

Card E.6.c FORMAT (I6)

NTMPTS The number of time points or cards required to define the time dependent wind force function on Cards E.6.d.

Not required for velocity dependent wind force functions (DO ≠ 0 on Card E.6.b).

Cards E.6.d FORMAT (4F12.0)
(NTMPTS cards)

T Time (sec.) associated with the time dependent wind force function pressure vector or time dependent drag coefficient given below. Values should be in ascending order with first value equal to zero.

FX,FY,FZ If a time dependent wind force function, the x, y and z components of pressure [force per unit area (lbs./in.**2)] due to the wind blast at time T. The components of the pressure vector are with respect to the local coordinate system of segment D4 specified on Card E.6.b. The program will use linear interpolation on T. If the last value of T is exceeded, the corresponding last values of FX, FY and FZ will be used for the remainder of the run.

If a time dependent drag coefficient function, FX is the drag coefficient (dimensionless) at time T, while FY and FZ are not used. The same interpolation scheme and approach for time greater than the last T used for the time dependent wind force option also applies for the drag coefficient function.

If NJNTF=0 on Card D.1, Cards E.7 are not required. Otherwise, NJNTF (from Card D.1) sets of Cards E.7.a - E.7.d are required. The E.7 cards can be used to provide joint flexural spring characteristics that are dependent on two joint angles, flexure, THETA and azimuth, PHI. This joint spring characteristic can be defined as a two dimensional matrix of joint torque values, at evenly spaced values of THETA and PHI, or as a set of polynomials dependent on PHI, for evenly spaced values of THETA.

Card E.7.a FORMAT (I4, 4X, 5A4)

I,KTITLE — Same as Card E.1 except that each function number (I) must be less than 51 and must be distinct from those supplied on Cards E.1 or Cards E.6.a.

Card E.7.b A blank card is required.

Card E.7.c FORMAT (2I6)

NTHETA — Magnitude indicates the number of columns in the two dimensional input data matrix to be supplied on Cards E.7.d. The minimum value is 2. If positive, the NTHETA entries in each row will be tabular data for equally spaced values of the joint flexure angle (THETA) between 0 and 180 degrees. If negative, the entries will represent the coefficients of a (|NTHETA|-1) order polynomial in (THETA-THETA0).

NPHI — The number of rows of the matrix of data to be supplied on Cards E.7.d-E.7.n. Each row represents equally spaced values of the joint azimuth angle (PHI) between -180 and +180 degrees, but does not include the last row since the program assumes data for PHI(NPHI+1)=180 are the same as for PHI(1)=-180. Minimum = 1.

Cards E.7.d FORMAT (5F12.0)

(NPHI sets of cards. Use extra cards per set if |NTHETA| > 5.)

THETA0	The value of the 'dead band' zone for this value of PHI (DEGREES). If the flexure angle (THETA) is less than THETA0, the joint restoring torque will be zero.
F(J),J=2,NTHETA	For NTHETA positive, tabular values of the joint restoring torque (in-lbs) for flexure angles: THETA(J) = (J-1)*180/(NTHETA-1) degrees Values of zero should be supplied for THETA < THETA0. For NTHETA negative, the coefficients of a polynomial for the joint restoring torque (in-lbs) in (THETA-THETA0) of order one less than the magnitude of NTHETA. F(J) is the coefficient of (THETA-THETA0)**(J-1) where (THETA-THETA0) is expressed in radians.

F. Subroutine FINPUT (allowed contacts)

On many of the F Cards, a segment number to which a plane or ellipsoid is attached is required. These segment numbers refer to the index I for the segments defined on the B.2 cards, the vehicle segment number from the C cards or the ground segment number. The inertial or ground segment is assigned a segment number NGRND. Where NGRND is equal to the sum of NSEG (Card B.1), the number of vehicles (Cards C), NBAG (Card D.1) and one.

If NPL is nonzero on Card D.1, Cards F.1 are required.

Card F.1.a	FORMAT (18I4) If NPL>18, use 2 cards.
MNPL(J),J=1,NPL	For plane J, the number of segments for which segment-plane contact is allowed. NPL is the number of planes from Card D.1. The value of any MNPL for plane J may be zero and the maximum value is 5. However, if it is required to have more than 5 segments contact the same plane, set up two or more identical planes and permit a maximum of 5 segments to contact each plane. The maximum total number of plane-segment contacts is 70.

For each plane J, MNPL(J) cards of the following must be supplied.

Cards F.1.b	FORMAT (10I4)
NJ	The plane number for which contact is allowed. NJ must correspond to J above. There must be MNPL(J) cards with this same NJ. If MNPL(J) = 0, no NJ = J should be present.
NS(1)	The segment number to which plane J is attached.
NS(2)	The segment number (determined by the card number I under Card B.2.a) for which contact with the NJth plane is allowed.

Cards F.1.b (continued)

NS(3)	The number of the contact (hyper)ellipsoid associated with the segment NS(2). If negative, the contact location printed in the tabular time history for this contact will be in the local reference coordinate system of segment NS(2), if positive, it will be for segment NS(1).
NF(1)	The function No. from Card E.1 to define the force deflection function for this contact. If NF(1)=0, a roll-slide constraint will be exercised by the program for this contact which does not require NF(2), NF(3) or NF(4) but does require a friction coefficient function to be defined by NF(5). Also, the initial positions on Cards G.2 must be such that there is no contact at time = 0. Note: The roll-slide option cannot be used with hyperellipsoids.
NF(2)	If positive, the function No. from Card E.1 to define the inertial spike function for this contact. If zero or negative, no inertial spike exists. If negative, the magnitude specifies the function No. for F2 of the rate dependent functions described below.
NF(3)	If positive, the function No. from Card E.1 to define the R (energy absorption) factor function. A value of R=1 indicates that all energy is recovered (no loss) and R=0 indicates that no energy is recovered. If NF(3)=0, R=1 is assumed (default). If negative, the magnitude specifies the function No. for F3 of the rate dependent functions described below.

Cards F.1.b (continued)

NF(4) — If positive, the function No. from Card E.1 to define the G (permanent deflection) factor function. If NF(4)=0, G=0 is assumed (default).

If negative, the magnitude specifies the function No. for F4 of the rate dependent functions described below.

NF(5) — The function No. from Card E.1 to define the friction coefficient function. If a roll-slide constraint is used for this contact (NF(1)=0), the value of D3 on Card E.2 for this function should be 0.5.

Note: By defining NF(2), NF(3) and NF(4) as all negative, the contact force is defined by deflection and rate dependent functions, instead of the inertial spike, R factor and G factor functions. The combined deflection and rate dependent function is defined by:

When $D>0$, $F(D,D') = F1(D) + F2(D)*F3(D') + F4(D')$

When $D<0$, $F(D,D') = 0$.

Where D and D' are the deflection and rate of deflection and F1, F2, F3 and F4 are functions specified by NF(1), NF(2), NF(3) and NF(4), respectively. If NF(2), NF(3) or NF(4) is zero, the corresponding function (F2, F3 or F4) is zero.

Note: There can not be a mix of positive and negative values for NF(2), NF(3) and NF(4), i.e. they must all be either zero or positive, or they must all be zero or negative.

Care must be taken in defining F1(D), F2(D), F3(D') and F4(D'), so that F(D,D') is not negative for any possible values of D and D'.

Cards F.1.b (continued)

NX	Indicator for the plane-segment edge effect option and infinite plane options:
	NX=0 - standard finite plane test. No force is applied unless the center of the intersecting ellipse is within the plane boundaries. No force is applied for complete penetration of the (hyper)ellipsoid.
	NX>0 - edge effect test. When only part of the intersecting ellipse is within the plane boundaries, the deflection and corresponding force are calculated at the centroid of the area of the ellipse that is within the plane boundaries. No force is applied for complete penetration of the (hyper)ellipsoid. This option cannot be used with a hyperellipsoid that has unequal powers.
	NX=-1 - the plane is assumed infinite. Therefore no boundary test is made. No force is applied for complete penetration of the (hyper)ellipsoid.
	NX=-2 - the plane is assumed infinite. Therefore no boundary test is made. A force is applied for complete penetration of the (hyper)ellipsoid.
	NX<-2 - standard finite plane test. No force is applied unless the center of the intersecting ellipse is within the plane boundaries. A force is applied for complete penetration of the (hyper)ellipsoid.

If NBLT is nonzero on Card D.1, Cards F.2 are required.

Card F.2.a	FORMAT (8I4)
MNBLT(J),J=1,NBLT	For belt J, the number of segments for which segment-belt interaction is allowed. NBLT is the number of belts from Card D.1. Each MNBLT may have a value of only 0 or 1.

For each belt J, MNBLT(J) cards F.3.b must be supplied.

Cards F.2.b	FORMAT (9I4)
NJ	The belt number to be contacted, must correspond to J above. There must be MNBLT(J) cards with the same NJ. If MNBLT(J) = 0, no NJ = J should be present.
NS(1)	The segment number to which belt NJ is attached.
NS(2)	The segment number (determined by the card number I under Card B.2.a) for which interaction with the NJth belt is allowed.
NS(3)	The number of the contact ellipsoid associated with the segment NS(2). Note: Hyperellipsoids can not be used with this option.
NF(1)	The function number from Card E.1 to define the force-deflection function for this contact. The abscissa for this function should be strain (in/in).
NF(I),I=2,4	Same definition as on Card F.1.b above.
NF(5)	If non-zero, full belt friction is assumed, i.e., forces are computed for each half of the belt separately. If zero, zero belt friction is assumed, i.e., belt tension is the same at both belt anchor points.

Note: The use of rate dependent functions as defined under cards F.1.b is not permitted for belt-segment contacts.

Card F.3.a is always required. It may be blank to specify that no segment-segment forces are to be computed by the program.

Card F.3.a   FORMAT (18I4) If NSEG>18, use two cards.

MNSEG(J),J=1,NSEG	For segment J, the number of segments for which segment-segment contact is allowed. NSEG is the number of segments from Card B.1. Each segment contact, A versus B, may be inputted either way except where an interior contact is desired (see NS(3)). Any or all values of MNSEG may be zero. The maximum value for each MNSEG is 5. The maximum total number of segment-segment contacts is 40.

For each segment J, MNSEG(J) cards F.3.b must be supplied.

Cards F.3.b   FORMAT (9I4)

NJ	The segment number to be contacted, it must correspond to J above. There must be MNSEG(J) cards with this same NJ. If MNSEG(J) = 0, no NJ = J should be present.
NS(1)	The number of the contact (hyper)ellipsoid associated with segment NJ. A hyperellipsoid must have equal powers.
NS(2)	The segment number (determined by the card number I under Card B.2.a) for which contact with the NJth segment is allowed.
NS(3)	The number of the contact (hyper)ellipsoid associated with the segment NS(2). A hyperellipsoid must have equal powers. If negative, an interior contact will be assumed with ellipsoid NS(1) inside NS(3). Hyperellipsoids can not be used for interior contacts.
NF(I),I=1,5	Same definitions as on Card F.1.b above.

Note: The use of rate dependent functions, as defined under Cards F.1.b, is permitted for segment-segment contacts.

If NJNT is nonzero on Card B.1, Card F.4.a is required. Supply IGLOB=1 for globalgraphic option, otherwise supply 0 or blank.

Card F.4.a	FORMAT (18I4) If NJNT>18, use two cards.
IGLOB(J),J=1,NJNT	For each joint J, supply 1 for IGLOB(J) if IPIN(J) is +3 or -3 on Cards B.3.a - B.3.j; otherwise supply zero or blank. One card F.4.j must be supplied below for each J for which IGLOB(J) =1.

Cards F.4.b	FORMAT (9I4)
NJ	The identification number for a globalgraphic joint, must correspond to J above and cards must be supplied in ascending order on NJ.
NS(I),I=1,3	Currently not used by program.
NF(1)	The function number from Card E.1 to define the torque-deflection for this globalgraphic joint. The ordinate for this function should be torque (in.-lb.) and the abscissa is the angular deflection (radians) into the stop.

NF(2)

The function number from Card E.1 to define the Herron formulas for T (joint stop angle in radians) and its derivative TP with respect to PHI both as functions of PHI (the joint angle from the reference axis in radians). Normally they will be computed by:

T = P1 + SP*P2
TP = P1' + CP*P2 + SP*P2'

where P1, P2 are the 5th degree polynomial evaluations of COS(PHI) using the two polynomials F1 and F2 obtained by setting both D1, D2 > 0 on Card E.2;

P1', P2' are their derivatives with respect to PHI;

and CP, SP are COS(PHI) and SIN(PHI).

If D1, D2 are not both positive, T and TP will be evaluated as functions of PHI in radians (0 < PHI < 2*PI) as specified on Cards E.1 - E.4 for function NF(2).

NF(I),I=3,5

Same definitions as on Card F.1.b above except that the use of rate dependent functions is not permitted.

If NJNT>0 (Card B.1) and NJNTF>0 (Card D.1), Card F.5.a is required.
If NJNT>0 and NJNTF=0, the program will set the JOINTF array to zero and Card F.5.a is not required.

Card F.5.a	FORMAT (18I4) use two cards if NJNT > 18.
JOINTF(J),J=1,NJNT	For each joint (J), the function identification number as supplied on Cards E.7.a to be used by Subroutine VISPR to compute the joint restoring force by Function FNTERP. If zero, the values of SPRING(1,3*J-2) as supplied on Cards B.4.a will be used using Function EJOINT.

If NBAG ≠ 0, NBAG cards of the following must be supplied. Since the air bag routines do not use the force-deflection functions, this input has different formats than for the above allowed contacts.

Cards F.6	FORMAT (2I4, 20I2)
K	The air bag number corresponding to the index J under Cards D.4 above. K must be in numeric order K = 1 to NBAG, where NBAG is the number of air bags defined on Card D.1.
NK	The number of segments allowed to contact the Kth air bag. The maximum value is 10. If NK = 0, the remainder of the card is blank.
MBAG(2,I,K), MBAG(2,I,K),I=1,NK	The segment numbers (determined by the card number I under Card B.2.a) each followed by the number of the associated contact ellipsoid for which contact forces with the Kth air bag will be computed. Note: Hyperellipsoids can not be used with the airbag routines.

If NWINDF=0 on Card D.1, Cards F.7 are not required and the program will set the MWSEG array to zeros. Otherwise, Cards F.7 are required.

Card F.7.a	FORMAT (18I4) use two cards if NSEG > 18.
MWSEG(1,J),J=1,NSEG	For each segment J, supply zero if no wind force calculations are to be performed. Otherwise, supply a value of one to indicate wind forces are to be computed.

Supply a Card F.7.b for each segment (J) where MWSEG(1,J) = 1.

Card F.7.b	FORMAT (7I4,22I2/28X,8I2)
JJ	The segment identification number from Cards B.2.a for which wind force calculations are to be performed. Must correspond to J from Card F.7.a and be supplied in ascending order. If negative the wind force will be calculated using an overlaying grid, allowing for blocking by other segments. (Note: This option may significantly increase run time.)
MWSEG(2,J)	The number of the contact ellipsoid to be associated with segment number JJ. Hyperellipsoids can not be used with this option.
MWSEG(3,J)	The segment identification number (MSEG+1 for the vehicle associated with plane number MWSEG (4,J).

Card F.7.b (continued)

MWSEG(4,J)	The plane identification number from Card D.2.a through which if segment J passes, wind force calculations will be performed.
MWSEG(5,J)	The function number from Card E.6.a for the wind force function to be used.
MWSEG(6,J)	The function number from Card E.6.a for the drag coefficient function to be used. If zero or blank, 1.0 will be used for the drag coefficient.
MWSEG(7,J)	Number of segments that may block segment JJ from the wind force. Only used if JJ is negative.
(MOWSEG(2K-1,J), MOWSEG(2K,J)), K=1,MWSEG(7,J)	The segment identification number and contact ellipsoid number of the possible segments blocking segment JJ from the wind force. Used only if JJ is negative. If MWSEG(7,J) >11, use a second card, leaving the first field of 28 columns blank. If MWSEG(7,J) = 11, a second card, completely blank should follow this card.

F.8 Subroutine HINPUT - Card input for harness-belt systems.

If NHRNSS ≠ 0 on Card D.1, Cards F.8 must be supplied.

Card F.8.a	FORMAT (5I4)	
	NBLTPH(I), I=1,NHRNSS	Number of individual belts for each harness No. I. May be zero or blank. Maximum value of the sum of all NBLTPH is 20.

Card F.8.a is followed by NHRNSS sets of Cards F.8.b - F.8.d.

Card F.8.b	FORMAT(18I4) use two cards if NBLTPH(I)>18.	
	NPTSPB(J), J=1,NBLTHP(I)	The number of reference points including anchor points for belt No. J of harness No. I. May be zero or blank. The maximum value of the sum of all NPTSPB for all harness-belt systems is 100. The maximum value of the sum of all NPTSPB for any one harness belt system is 50. The maximum value of any individual NPTSPB is 25.

Each Card F.8.b is followed by NBLTPH(I) sets of Cards F.8.c - F.8.d.

Card F.8.c	FORMAT (5I4, F12.0)	
	NF(L),L=1,5	The function numbers from Cards E.1 to define the stress-strain of belt No. J. The definition of these functions are identical to those of NF(1) to NF(5) on Cards F.2.b, except that the use of rate dependent functions is permitted. NF(5) is currently not used by the program.
	XLONG(J)	The initial slack (in) of belt No. J. A negative value can be specified to indicate a pre-tightened belt. The program will add this to the initial geometric length to obtain the initial belt length and distribute the slack proportionately between the points.

Each Card F.8.c is followed by NPTSPB(J) pairs of F.8.d1 and F.8.d2 cards to specify the reference points (K) for belt (J) of harness (I).

Card F.8.d1 FORMAT (9I4, 3F12.0)

KS
: The segment associated with reference point (K). If a tie-point is being used, KS is the sum of this segment number and 100*KTP, where KTP is a tie-point identification number. All points (K) of harness (I) that have the same non-zero value for KTP (there should be only one for each belt (J)) will be connected and should have identical values for all other input.

KE
: The identification number of the contact ellipsoid associated with reference point No. K. If no ellipsoid is specified (KE=0), the program will assume a unit sphere. Hyperellipsoids can not be used with the harness belt option.

NPD
: Indicator for the preferred direction option. If a non-zero integer is given, a non-zero vector must be specified for BAR(L,K), L= 10, 12 on Card F.8.d2. The reference point will be allowed to move along the surface in a direction which is perpendicular both to this vector and to the normal of the surface subject to the constraint imposed by D2 of function NF(5) below. If NPD=0, the nominal belt line is used in place of this vector. NPD must be nonzero if point No. K is a tie-point. Note: Specifying a preferred direction (NPD ≠ 0) requires that the reference point be allowed to move (NDR ≠ 0). If the belt is permitted to slip (NDR = 0), there must be no preferred direction option (NPD = 0).

NDR
: Indicator for the delta R option. If NDR = 0, belt (J) will be allowed to slip at reference point (K). If NDR ≠ 0, belt (J) will not slip but reference point (K) will be moved along the nominal belt line. In both cases the slippage or motion is subject to the constraint imposed by the coefficient of friction given by D4 of function NF(5) below. NDR must be non-zero for end reference (tie or anchor) points of the belt.

Card F.8.d1 (continued)

MF(L),L=1,4	The function numbers from Cards E.1 to define the force deflection function between belt (J) and reference point (K). If MF(1) = 0, the surface is treated as rigid and no perturbation of the reference point normal to the surface is allowed. The use of rate dependent functions, as defined under Cards F.1.b, is permitted.
MF(5)	The function number from Card E.1 to define the friction coefficients for belt (J) at reference point (K). Two constant values are to be defined on Card E.2 of this function by setting DD = D1 = D3 = 0. D2 is the coefficient of friction perpendicular to the nominal belt line along the surface and D4 is the coefficient of friction along the nominal belt line. If MF(5) = 0, infinite friction is assumed. It should be noted that the anchor point is treated as any other point. Therefore, if the anchor point is to be rigidly attached, MF(5) = 0 must be supplied. Even with the anchor point rigidly attached, it can still move along the normal to the ellipsoid (K ≠ 0) or to the unit sphere (K = 0) because of penetration. If the anchor point is not to move at all, MF(1) = 0 should also be supplied.
BAR(L,K),L=1,3	The x, y and z coordinates (in) of reference point (K) of belt (J). If a contact ellipsoid is specified (K ≠ 0), the vector is assumed to be orientated with respect to the local coordinate system KS, but translated such that its linear dimensions are with respect to the center of the contact ellipsoid KE. The supplied values will be adjusted by the program to lie on the ellipsoid surface. If no contact ellipsoid is specified (K = 0), a nonzero vector, specified in the local coordinate system of KS, must be supplied. This vector specifies the direction of the normal in the perturbation coordinate system used to resolve the belt segment forces. The program will assume that belt (J) will run through the points in the specified order. However, if the forces are such as to pull the belt away from the surface, this point will be ignored if it is not a tie or anchor point.

Card F.8.d2 FORMAT (6F12.0)

BAR(L,K), L=7,9	If KE = 0, i.e. no contact ellipsoid, the x, y and z coordinates (in) of the offset in the local coordinate system of segment KS. This vector is added to the reference vector defined above (L=1,3) to determine the location of the reference point (K) relative to the center-of-mass of segment KS. If KE ≠ 0, i.e. there is a contact ellipsoid, any supplied value is ignored and the ellipsoid offset value P2(I) specified on Card D.5 is used instead.
BAR(L,K), L=10,12	The x, y and z coordinates of a vector in the local coordinate system of segment KS. This vector is used for the preferred direction (see NPD above). This vector must not be parallel to the normal computed from BAR(L,K), for L=1,3 above.

G. Subroutine INITAL

Card G.1.a FORMAT (3F10.0, 5I4)

ZPLT(I),I=1,3	The x, y, and z printer plot coordinates (for Subroutine PRIPLT) of the origin of the primary vehicle reference system. $0 < X < 61$ $0 < Y < 61$ $0 < Z < 121$
I1	A value of 15 is required to call Subroutine EQUILB and process Cards G.4, G.5 and G.6.
J1	If non-zero, Card G.1.b is required to define scaling information for the printer plots.
I2,J2	Currently not used by the program.
I3	If zero, segment linear and angular velocities are not supplied on the following cards but are set equal to the initial primary vehicle velocity. If I3 $\neq$ 0, SEGLV and WMGDEG must be supplied on cards G.2 and G.3.

If J1 is zero or blank on Card G.1.a, the following Card G.1.b should not be supplied and default values of 10.0, 6.0 and 1.0 will be used for the SPLT array.

Card G.1.b	FORMAT (3F10.0)
SPLT(1)	The number of horizontal print positions per unit length for the output unit that will print the printer plots produced by Subroutine PRIPLT (normal value is 10.0 for 10 spaces or columns per inch).
SPLT(2)	The number of vertical print lines per unit length (normal values are 6.0 or 8.0 for 6 or 8 lines per inch). The program uses only the ratio of SPLT(1) to SPLT(2).
SPLT(3)	Scale factor that represents the distance (inches or length unit on Card A.3) between vertical print lines for the printer plots. Note: The printer plot was originally designed for 120X60 units (inches) along the z and x or y directions which may not be satisfactory for certain situations (e.g., metric units).

One G.2 card must be supplied for each reference segment (i.e., segment No. 1 and for each segment J where JNT(J-1) = 0 on Cards B.3) in ascending segment number sequence.

Cards G.2	FORMAT (6F10.0)
SEGLP(I,J),I=1,3	The initial x, y, and z coordinates of reference segment J in the inertial reference (in).
SEGLV(I,J),I=1,3	The initial x, y, and z components of velocity of reference segment J in the inertial reference (in/sec). These fields may be left blank if I3 = 0 on Card G.1 in which case the initial velocity of the primary vehicle will be used.

NSEG sets of cards G.3.a-G.3.b are required.

Cards G.3.a	FORMAT (6F10.0, 4I3)
YPR(I,J),I=1,3	The initial rotation angles (degrees) of the Jth segment about the local z, y and x axes of the segment given by ID(4,J) in the order specified by ID(I,J),I=1,3 below.
WMGDEG(I,J),I=1,3	The initial components of angular velocity about the local x, y and z axes of the Jth body segment (deg/sec). If I3 = 0 on Card G.1, the initial angular velocity of the primary vehicle will be converted to the segment reference and used.
ID(I,J),I=1,3	Indicators used to specify the order of the axes of the rotations given in YPR above. (See complete definition under Cards B.3.a2.) Zeros or blanks will default to 1, 2 and 3 to indicate that the standard sequence of yaw. pitch and roll is reversed (as required by versions previous to 18A of the program). Values of 3, 2, 1 indicate that the standard yaw, pitch and roll sequence will be used.

Values of 3, 1, -3 indicate that precession, nutation and spin for Euler joints will be used.

A negative value for ID(1,J) indicates that projections or projection angles of the local axes of segment J will be used instead of the initial rotation angles and that a Card G.3.j2 will follow this card.

ID(4,J) — The segment number to which the rotations given by YPR or by the angles on Card G.3.j2 are with respect to. A value of zero or blank will default to the ground (MSEG+NBAG+2) or inertial reference. The primary vehicle may be specified by supplying MSEG+1, where MSEG is either NSEG or the largest MSEG from Cards C.2a. Otherwise, the number of the segment must be less than J. A negative number (-|JNT(J-1)|, as specified on Card B.3.a1) may be used to define the rotation angles with respect to the joint axes as specified on Card B.3.a2.

Note: The values of YPR and ID are used to compute a direction cosine matrix R. The direction cosine matrix D(J) of segment J is determined by the value of K = ID(4,J) as follows:

K = 0:	D(J) = R(J)	(K=0 or equal to NGRND)
K > 0:	D(J) = R(J)D(K)	(K<J or equal to NVEH)
K < 0:	D(J) = H'(J)R(J)H(K)D(K)	(K = -|JNT(J-1)|)

There are no restrictions on a ball or Euler joint. An Euler joint can be set to an initial precession(P), nutation(N) and spin(S) by specifying YPR = P, N, S and ID = 3, 1,- 3, -|JNT(J-1)|. To preserve the axes of a pin joint, the relative orientation of segments J and JNT(J-1) must represent a rotation about the pin axis only. (The pin axis is always the y axis of the joint axes as specified on Card B.3.a2.) This can be assured by supplying YPR = 0, P, 0 and ID = 0, 0, 0, -|JNT(J-1)|, where P is the pitch of segment J with respect to the center of symmetry (Card B.3.a2) of joint J-1. For the case where the y axes of segments J and JNT(J-1) are parallel to the pin axis, the pin axis can be preserved by supplying values of YPR = 0, P, 0 and ID = 0, 0, 0, |JNT(J-1)| where P is the pitch of segment J with respect ot segment JNT(J-1).

A Card G.3.b must follow every Card G.3.a on which ID(1,J) is negative.

Cards G.3.b FORMAT (6F10.0, 4I3)

A1,A2,A3 — Specifies the projection of the primary axis given by IK below. If II is negative, values will be the x, y and z components (in) in the projection reference system of a vector along the positive IK axis of segment No. J. If II is positive, A1, A2 (A3 not used) are the projection angles (deg) of the positive IK axis of segment number J in two of the projection reference planes specified by the value of II.

B1,B2,B3 — Specifies the projection of a secondary axis given by JK below. The definition is identical to A1, A2, A3 above but uses JJ and JK instead of II and IK.

II — If II is negative, the components of a vector along the positive IK axis will be given by A1, A2, A3. If II is positive, a value of 1, 2 or 3 is used to indicate that the x, y or z axis is the common axis of the two projection reference planes used to specify the two projection angles as follows:

If II=1, A1 in z-x plane, A2 in x-y plane.
If II=2, A1 in x-y plane, A2 in y-z plane.
If II=3, A1 in y-z plane, A2 in Z-X plane.

In the x-y plane, the angle is measured from the x axis, positive toward the y axis.

In the y-z plane, the angle is measured from the y axis, positive toward the z axis.

In the z-x plane, the angle is measured from the z axis, positive toward the x axis.

Restriction: SIN(A1)*COS(A2) cannot be zero.

Cards G.3.b (continued)

IK	A value of 1, 2 or 3 to specify that the x, y or z axis of segment number J is the primary axis to be projected.
JJ,JK	Same definition as for II, IK above but for a secondary axis of segment number J. The value of JK must be different than that of IK.

Subroutine EQUILB

Cards G.4, G.5 and G.6 are required if I1 = 15 on Card G.1.

Card G.4	FORMAT (2I4)
NVAR	No. of independent variables supplied on Cards G.2 and G.3 that are to be adjusted such that contact normal forces are equal to either Gx supplied on Cards G.5 or constraint normal forces controlled by Cards G.6 (max = 10).
NCON	No. of constraints to be imposed to compute those constraint forces which will be satisfied by initial contact forces. If zero, the supplied values of Gx will be used, (max = 5).

Cards G.5 (NVAR cards)	FORMAT (3I4, 2F8.0, 8I4)
NTV(J)	Indicates type of Jth independent variable 1 - SEGLP from Cards G.2 2 - YPR from Cards G.3
NI1(J)	A value of 1, 2 or 3 to indicate the x, y or z coordinate of SEGLP if NTV(J)=1, or yaw, pitch or roll of YPR if NTV(J)=2.
NSG(J)	The segment number (as specified by index I of Cards B.2) for the Jth independent variable.
GX(J)	The magnitude of the contact normal force for the Jth independent variable (lbs.). If this contact is to be controlled by a constraint on Cards G.6 (i.e., J=INDGX(I)), the supplied value of Gx will be the initial value for the iteration of the contact normal force to equal the constraint normal force; otherwise, the Jth independent variable will be adjusted such that the contact normal force will be equal to Gx.

Cards G.5 (continued)

XDEV(J)	The maximum allowable deviation from the initial positions specified on Cards G.2 and G.3 during the iteration of the Jth independent variable for the contact normal force to equal Gx. If exceeded, the program will terminate with an error message. If XDEV = 0, the tests will not be performed.
JPL(J)	The plane number corresponding to NJ on Cards F.1.b - F.1.n for the contact whose normal force is to be controlled by the Jth variable.
JSG(J)	The segment identification number (as specified by index I of Cards B.2) involved in the contact with plane No. JPL(J). Note: A contact between this plane and segment must have been set up on Cards F.1.b - F.1.n.
NAV(J)	No. of variables associated with the Jth independent variable. (Max= 5, may be zero.)
KSG(I,J),I=1,NAV	The segment numbers (definition same as for NSG(J)) for the NAV(J) variables associated with the Jth independent variable. Any change made to the Jth independent variable to achieve initial equilibrium will also be made to the corresponding variables for these segments such that the initial relative orientation will be maintained as specified on Cards G.2 and G.3.

Cards G.6 FORMAT (4I4)
(NCON cards)

IPL(I),ISG(I)	The plane and segment numbers (definition same as for JPL(J) and JSG(J) above) for the Ith constraint to be imposed for initial equilibrium during the contact normal force to constraint normal force iteration.
LTYPE(I)	Indicates the type of the Ith constraint: 3 - Roll constraint, 4 - Slide constraint.
INDGX(I)	The index J (from 1 to NVAR) from Card G.5 for which the contact normal force will be iterated to be equal to the Ith constraint normal force. May be zero, but if INDGX(I) = J, then IPL(I) and ISG(I) must be equal to JPL(J) and JSG(J).

Note: Subroutine EQUILB will adjust the initial position parameters supplied on Cards G.2 and G.3. If the constraints temporarily imposed by Cards G.6 properly constrain all of the segments, zero accelerations will be obtained while the constraints are on. The iteration will produce normal and tangential contact forces that will result in small (< 0.02 G) initial linear accelerations for all of the body segments. For the seated 'standard' fifteen segment occupant, this can be achieved as follows:

A. Lock joint P, W, NP, HP, RA and LA by setting IPIN = -2 on Cards B.3. If the maximum torque for a locked joint (T1 for VISC(4,3*J-2) on Cards B.5) is zero, then Subroutine EQUILB will set T1 for these locked joints to 1.5 times the magnitude of the joint torque finally produced at time zero.

B. Constrain the arms by either setting up fixed point constraints (type = 1) for the RLA and LLA with the vehicle on Cards D.6, or lock the joints RS, RE, LS and LE as in step A above. If the constraints are imposed on Cards D.6, Subroutine EQUILB will adjust the point on the vehicle (RK2 on Cards D.6) for any type 1 constraint involving the vehicle so that it will coincide with the specified point on the body segment (RK1 on Cards D.6) as adjustments are made to the initial position parameters.

C. Set up allowed contacts and associated force deflection functions on Cards F.1 for the seat cushion plane with the LT, RUL and LUL segments, the seat back plane with the LT, CT and UT segments, and the floorboard plane with the RF and LF segments.

D. Set up initial position parameters on Cards G.2 and G.3 that are just 'short of' or close to the final penetration distances for the segments with the contact planes.

E. Set NVAR = 5 and NCON = 4 on Card G.4.

F. Supply the following input parameters on Cards G.5:

J	NTV	NI1	NSG	GX	XDEV	JPL	JSG	NAV	KSG
1	1	3	(LT)	90.0	1.0	(seat cushion)	(LT)	0	
2	1	1	(LT)	5.0	1.0	(seat back)	(LT)	0	
3	2	2	(UT)	10.0	5.0	(seat back)	(UT)	4	(LT), (CT), (N), (H)
4	2	2	(RUL)	25.0	10.0	(seat cushion)	(RUL)	1	(LUL)
5	2	2	(RLL)	10.0	10.0	(floorboard)	(RF)	1	(LLL)

G. Supply the following input parameters on Cards G.6:

I	IPL	ISG	LTYPE	INDGX
1	(seat cushion)	(LT)	3	1
2	(seat back)	(UT)	4	3
3	(floorboard)	(RF)	3	5
4	(floorboard)	(LF)	3	0

Using the above input parameters, Subroutine EQUILB will adjust the x and z coordinates of the LT, the pitch angles (maintaining the initial relative orientation) of the UT, LT, CT, N and H segments, the RUL and LUL segments, and the RLL and LLL segments, and the initial normal contact forces (Gx) of the seat cushion with the LT, the seat back with the UT and the floorboard with the RF. It is believed that the resulting initial positions are unique and are functions of the values of the contact normal forces (Gx) supplied for the seat back with the LT and the seat cushion with the RUL contacts.

H. Subroutine OUTPUT

This subroutine provides input to control the desired time history output of selected total and angular accelerations, velocities, displacements, joint parameters, joint forces and torques, wind force data and total body properties.

H.1 (K=1) Linear acceleration time history output.

Card H.1.a	FORMAT (I6, 2I3, 3F12.6)
NSG(K)	The number of selected points on the various body segments for which time histories are desired. The maximum value for NSG(K) is 20. If NSG(K) is 0, insert 2 blank cards. If NSG(K) is 1, a single blank card should follow card H.1.K.
KREF(1,K)	The reference segment number the first point total accelerations are to be given in. If zero or blank, the default will be the MSG segment number the point is attached to, i.e. the local reference system. Note that all previous input decks can be used without modification and will default to the local reference system of segment MSG. If MSG is negative, KREF is the initial accelerometer setting. In this case KREF must be 0 or 1. If KREF=0, there is no gravity vector offset; if KREF=1, the initial accelerometer value = 1G along the gravity vector specified by Card A.3. However this offset remains in the local MSG coordinate system. The accelerations will be in the local coordinate system when MSG is negative.
MSG(1,K)	The segment number of the first point as determined by the index I on Cards B.2. A vehicle or airbag may be specified by their segment number. If MSG is negative, the accelerations will correspond to the output of an accelerometer attached to MSG at the XSG point.

Card H.1.a (continued)

XSG(I,1,K),I=1,3	The x, y, and z coordinates in the segment reference of the first point (inches).

Followed by NSG(K)-1 Cards H.1.b (For J=2,NSG(K)). One H.1.b card is always required.

CARDS H.1.b	FORMAT (I9, I3, 3F12.6)
KREF(J,K)	Same as above but for the Jth point.
MSG(J,K)	Same as above but for the Jth point.
XSG(I,J,K),I=1,3	Same as above but for the Jth point.

H.2 (K=2) Relative velocity time history output.

Cards H.2.a	FORMAT (I6, 2I3, 3F12.6)
NSG(K)	Same description as for H.1.
KREF(1,K)	The reference segment number the point relative velocity is to be given in. If zero or blank, the default will be the vehicle. Note that all previous input decks can be used without modification and will default to the primary vehicle reference system.
MSG(1,K)	The segment number of the first point as determined by the index I on Cards B.2. A vehicle or airbag may be specified by their segment number.
XSG(I,J,K),I=1,3	Same description as for H.1.a

Followed by NSG(K)-1 Cards H.2.b (For J=2,NSG(K)). One H.2.b card is always required.

CARDS H.2.b	FORMAT (I9, I3, 3F12.6)
KREF(J,K)	Same as above but for the Jth point.
MSG(J,K)	Same as above but for the Jth point.
XSG(I,J,K),I=1,3	Same as above but for the Jth point.

H.3 (K=3) Relative displacement time history output

Cards H.3.a - H.3.b FORMAT (I6, 2I3, 3F12.6/ (I9, I3, 3F12.6))

Same description as for Cards H.2.a - H.2.b except for relative displacements.

H.4 (K=4) Segment angular acceleration time history output

CARD H.4	FORMAT (I6, 22I3/ (I9, 21I3))
NSG(K)	The number of selected segments for which time histories are desired (maximum = 20). Supply blank card if none are desired.
(KREF(J,K), MSG(J,K)),J=1,KSG where KSG=NSG(K)	KSG pairs of numbers. The first number of a pair (KREF) is the number of the reference segment the segment angular accelerations are to be given in. The second number of a pair (MSG) is the segment number whose angular acceleration is to be given. If KREF is zero or blank, the default will be the segment number, i.e. the local reference system. Note that all previous decks can be used without modification and will default to the local reference system. MSG is the segment number as determined by index I on Cards B.2. A vehicle or airbag may be specified by their segment number. If NSG(K) > 11, use the second card, leaving the first field of 6 columns blank. If NSG(K) = 11, a second card, completely blank should follow this card.

H.5 (K=5) Segment relative angular velocity time history output

Card H.5	FORMAT (I6, 22I3/ (I9, 21I3))
NSG(K)	Same description as for H.4
(KREF(J,K), MSG(J,K)),J=1,KSG where KSG=NSG(K)	KSG pairs of numbers. The first number of a pair (KREF) is the reference segment number the segment relative angular velocities are to be given in. The second number of a pair (MSG) is the number of the segment whose angular velocities are to be given. If KREF is zero or blank, the default will be the vehicle. Note that all previous input decks can used without modification and will default to the primary vehicle reference system. MSG is same as for Card H.4.

H.6 (K=6) Segment relative angular displacement time history output •

Card H.6 **FORMAT (I6, 22I3/ (I9, 21I3))** •

Same description as for Card H.5 except for relative angular displacements.

H.7 (K=7) Joint parameter time history output

Card H.7 **FORMAT (12I6/ (I12, 10I6))**

NSG(K)	The number of selected joints for which time histories are desired. Insert a blank card if none are desired (maximum 20).
MSG(J,K),J=1,KSG where KSG=NSG(K)	The joint numbers as determined by index J on Cards B.3. If NSG(K) > 11, use a second card leaving the first field of 6 columns blank. If NSG(K) = 11, a second card, completely blank, should follow this card.

H.8 (K=8) Wind force time history output %
(Note: These H.8 Cards are new as of Version III.2. What %
was previously the H.8 Card (the card for the HIC, HSI and %
CSI calculations is now Card H.11). Previous input decks %
will require a blank card at this point in the input deck %
to be compatible with ATB Version III.2 input requirements. %

Card H.8	FORMAT (I6, 22I3/ (I9, 21I3))	%
NSG(K)	The number of selected segments for which the wind force tabular time histories are desired. Insert a blank card if none are desired (maximum = 20).	% % % %
(KREF(J,K), MSG(J,K),J=1,KSG where KSG=NSG(K)	KSG pairs of numbers. The first number of a pair (KREF) is the reference segment number of the coordinate system the wind forces are to be given in. The second number of a pair (MSG) is the segment whose wind forces are to be given. If KREF is zero or blank, the default will be ground. MSG is the segment number as determined by index I on Cards B.2. If NSG(K) > 11, use a second card leaving the first field of 6 columns blank. If NSG(K) = 11, a second card, completely blank, should follow this card.	% % % % % % % % % % % % %

H.9 (K=9) Joint forces and torques time history output (Note: These H.9 Cards are new as of Version III.2. Any previous input decks will require a blank card at this point in the input deck to be compatible with ATB III.2 input requirements.) The joint forces are the forces required (at the joint location) to keep the joined segments from separating. The joint torques are the torques required to meet any angular constraint of the joint (e.g. for a pin joint only one axis of rotation is permitted) plus any torques transferred across the joint. The joint torques applied by the joint functions are a function of the relative position and relative velocity of the two joint coordinate systems. A detailed break out of the joint function torques is provided by the Cards H.7. Note: As of ATB III.4 the sign on the torques is reversed to be of the same sense as the forces.

Card H.9	FORMAT (I6, 22I3/ (I9, 21I3))
NSG(K)	The number of selected joints for which time histories are desired. Insert a blank card if none are desired (maximum = 20).
(KREF(J,K), MSG(J,K),J=1,KSG where KSG=NSG(K)	KSG pairs of numbers. The first number of a pair (KREF) is the reference segment number the joint forces and torques are to be given in. The second number of a pair (MSG) is the joint whose forces and torques are to be given. If KREF is zero or blank the default will be the vehicle. MSG is the joint number as determined by index J on Cards B.3. If NSG(K) > 11, use a second card leaving the first field of 6 columns blank. If NSG(K) = 11, a second card, completely blank, should follow this card.

H.10 Total body property time history output %
(Note: These H.10 Cards are new as of Version III.2. Any %
previous input decks will require a blank card at this %
point in the input deck to be compatible with ATB III.2 %
input requirements.) %

Card H.10.a	FORMAT (I6)	%
MCG	The number of bodies (collection of segments) for which time histories are desired (max = 5). Each time history will contain the center of mass, the total linear and angular momentum, and kinetic energy of the set of specified segments. If zero or blank, no Cards H.10.b are required.	%
Cards H.10.b (MCG cards)	FORMAT (24I3)	%
MCGR(J)	The segment number of the segment to which the center-of-mass is referenced.	%
MCGN(J)	The number of segments in the Jth set of segments (body) for which a tabular time history of body properties (maximum = 22) is specified.	%
MCGS(I,J),I=1,MCGN	The segment numbers of the MCGN segments that are to be included in the Jth set of segments (body).	%

H.11 (Subroutine POSTPR) - HIC, HSI and CSI calculations.

This card is required whenever Subroutine POSTPR is called as determined by the value of NPRT(4) on Card A.5 (all values except 0 and 4). This H.11 card was previously called the H.8 card. The number of time points that can be processed to compute the HIC, HSI and CSI values must be greater than or equal to 25 and less than or equal to 1000. If the number of time points is less than 25, the calculation(s) will be skipped and a warning message printed. These calculations can be performed only if NPRT(30) > 0 and (1/NPRT(30))*DT*NSTEPS < 1000 (it can not be = 1000 because of time step 0), or NPRT(30) = 0 and the the number of successful integration steps is < 1000. If NPRT(30) = 0, the data is written every successful integration step and the total number of points can not be determined beforehand. A quick way to determine the number of successful integration steps for a run is to look at the table produced by Subroutine ELTIME at the end of each run. The number of times Subroutine OUTPUT is called is equal to the the number of successful integration steps when NPRT(26) = 0, 1 or 4 and NPRT(4) > 0, i.e. output unit No. 8 (Subroutine POSTPR) is used. Recall that NPRT(30) is the frequency the injury data is to be written to the injury data array (a multiple of DT). DT is the time step for which data can be printed out and NSTEPS is the total number of integration steps the program is to make for a specific run.

If the injury functions are to be computed during a postprocessing run (NPRT(4) = -1 or -3), these calculations can only be made for data for specific time points that are on the TAPE 8 file saved from a previous integration run. This means that there is no capability to use data at time points requested by the logic of NSTEPS, NPRT(30) and DT of a postprocessing run when data were not written at these specific time points by the previous integration run, i.e. there is no capability to interpolate between data points from the integration run. Therefore, care must be taken to select DT, NSTEPS and NPRT(30) such that only data that are at the time points that were written on TAPE 8 or some integer multiple of these time points are used in the computation of the injury functions.

Card H.11	FORMAT (18I4)
JDTPTS(1)	The index J on Cards H.1 corresponding to the head center-of-mass whose resultant acceleration time history will be used to compute the head injury criteria (HIC) and head severity index (HSI). The computations *will not be done if* JDTPTS(1) = 0 or blank.
JDTPTS(2)	The index J on cards H.1 corresponding to the point whose resultant acceleration time history will be used to compute the chest severity index (CSI). The computations will not be done if JDTPTS(2) = 0 or blank.

I. Subroutine POSTPR

If NPRT(4) on Card A.5 is an even integer, Cards I are not required. (See note in Subroutine SLPLOT regarding program changes that may be necessary on plotting facilities that do not use a Calcomp graphics library.)

These cards essentially specify all of the arguments to Subroutine SLPLOT and the indices of the data in the tabular time histories to be plotted. The ability exists to plot any set of variables in the time histories as a function of any other variable on a fixed (specified by the user input) x-y axis. Both axes may be either linear or logarithmic. Any data falling outside of the specified range of each axis will be ignored. The input also specifies the x and y axis labels and two lines of plot identification that lies below the x axis label.

The number of time points for any variable that can be written to the data array for plotting is limited to 1000. Therefore, the plotting option can be used only if NPRT(30) > 0 and (1/NPRT(30))*DT*NSTEPS, < 1000 (it can not be = 1000 because of time step 0) or NPRT(30) = 0 and the the number of successful integration steps is < 1000. If NPRT(30) = 0, the data is written every successful integration step and the total number of points can not be determined beforehand. A quick way to determine the number of successful integration steps for a run is to look at the table produced by Subroutine ELTIME at the end of each run. The number of times Subroutine OUTPUT is called is equal to the the number of successful integration steps when NPRT(26) = 0, 1 or 4 and NPRT(4) > 0, i.e. output unit No. 8 (Subroutine POSTPR) is used. Recall that NPRT(30) is the frequency the plotting data are to be written to the plot data arrays (a multiple of DT). DT is the time step for which data are to be printed out and NSTEPS is the total number of integration steps the program is to make for a specific run.

If the plots are to be made during a postprocessing run (NPRT(4) = -1 or -3), plots can only be made from data for specific time points that are on the TAPE 8 file saved from a previous integration run. This means that there is no capability to plot data at time points requested by the logic of NSTEPS, NPRT(30) and DT of a postprocessing run when data were not written at these specific time points by the previous integration run, i.e. there is no capability to interpolate between data points from the integration run. Therefore, care must be taken to select DT, NSTEPS and NPRT(30) such that data are plotted at the time points that were written on TAPE 8 or some integer multiple of these time points.

Card I.1	FORMAT (18I4)
NPLT	The number of plots to be generated (max=20). (IF NPLT > 17, use two cards.)
NYP(K),K=1,NPLT	The number of y variables to be plotted vs. the same x variable for each of the NPLT plots. NPLT + sum of NYP is limited to 25. Note: The plotting algorithm assumes each of the NVP(K) y variables has the same x value. Therefore, unless the x axis is the time axis, where each y value does have the same x value for each plotting point, the plots will most likely be incorrect.

A set of Cards I.2-I.8 is required for each of the NPLT plots.

Card I.2	FORMAT (18I4)
MX1(K),MX2(K)	The page No. (MX1) and column No. (MX2) from the tabulated time histories of the x (horizontal) variable for the Kth plot. These page Nos. start with 21 so MX1 > 20. MX2 = 0 refers to time (msec), the leftmost column. MX2 can be supplied as a negative integer to indicate that the y value for time zero will be subtracted from all y values for plotting purposes.
MY1(J,K),MY2(J,K) for J=1,NYP(K)	The page No. (MY1) and column No. (MY2) for the NYP(K) y (vertical) variables to be plotted vs. the x variable specified by MX1 and MX2 for the Kth plot. Definition of each MY1, MY2 same as for MX1, MX2 above.

Card I.3 FORMAT (I4, 4X, 4F8.0)

NX(K)	The number of intervals or plotting decrements along the x (horizontal) axis for the Kth plot. There will be NX(K)+1 tic marks and numeric annotations, the first will be for XO(K) and the last for XN(K). If NX(K) is positive, the scale will be linear, and if negative, the scale will be logarithmic.
XO(K)	The value of the origin of the x axis for the Kth plot.
XN(K)	The value of the end of the x axis for the Kth plot. For NX(K) positive, XN(K) should equal XO(K) + NX(K)*DX, where DX is a reasonable plot decrement. If NX(K) is negative, both XO(K) and XN(K) should be powers of ten, where: XN(K) = XO(K)*10**|NX(K)|.
XL(K)	The length (plotting inches) of the x axis for the Kth plot. XL(K) should be at least one inch less than XS(K).
XS(K)	The paper size (plotting inches) in the x direction for the Kth plot. The plot will be centered within this dimension.

Card I.4 FORMAT (I4, 4X, 4F8.0)

NY(K),YO(K),YN(K), YL(K) and YS(K)	Same definitions as for the corresponding items on Card I.3.K but for the y (vertical) axis for the Kth plot. Note that each of the NYP(K) variables will be plotted on the same scale.

Card I.5	**FORMAT (I4, 4X, 15A4)**
NXLAB(K)	The number of characters in the label of the x axis for the Kth plot (max=60, may be zero).
XLAB(K)	The alphanumeric information to be used as the label of the x axis for the Kth plot. Data should be left adjusted as input since program will center the NXLAB(K) characters beneath the x axis.

Card I.6	**FORMAT (I4, 4X, 15A4)**
NYLAB(K), YLAB(K)	Same definition as for Card I.5.K but for the label of the y axis for the Kth plot.

Card I.7	**FORMAT (I4, 4X, 15A4)**
NPLB1(K)	The number of characters in the upper of two lines of plot identification for the Kth plot (max = 60, may be zero).
PLB1(K)	The alphanumeric information to be used in the upper line of the plot identification for the Kth plot. Data should be left adjusted as input since the program will center the NPLB1(K) characters beneath the x axis label.

Card I.8	**FORMAT (I4, 4X, 15A4)**
NPLB2(K), PLB2(K)	Same definition as for Card I.7.K but for the lower line of the plot identification.

Note: The 15A4 term in the format for Cards I.5-I.8 is to be used on computers where a single precision word is equivalent to *four* alphanumeric characters. This term is the format for Subroutine POSTPR and should be set to 10A6 or 6A10 for those computers whose single precision word size is equivalent to 6 or 10 characters. This is necessary to insure that a contiguous string of characters is stored in the computer memory, as required by Subroutine SYMBOL.

5.0 NUMBERED STOPS WITHIN THE ATB COMPUTER PROGRAM

There are many program stops within the ATB program to signal both input and run-time errors. Some of the stops have an accompanying message printed in the main output file, others do not. All are numbered and described below to help the user determine the cause of the program termination. For stops associated with the input routines, the actual input error is probably caused by missing or erroneous data of previous input records. The user is advised to check the output produced by the input routines (on logical unit 6) to determine at what point within the input file the error may have occurred.

The following is a list of all stops within the ATB-IV Model program, the subroutine involved, the input card number (where applicable), the reason for the stop and possible corrective action.

1. Main Program: Indicates the normal program stop. All activity requested by the user has been completed.

2. Subroutine RSTART: Indicates an improper variable name, index or type was supplied when the restart option was selected (IRSIN ≠0) on Card A.2. Refer to the message written to output unit 6 that indicates which A.2 input variable was at fault.

3. Subroutine BINPUT: Indicates an error in defining a flexible element on cards B.3. There must be at least two joints with a negative JNT per flexible element, one connecting the interior segment to the reference segment and the second connecting the interior segment to the terminal segment.

4. Subroutine BINPUT: Indicates that the value of NFX, the total number of flexible element interior segments specified on card B.7, does not agree with the value of NFLX, the total number of interior segments computed from the number of joints with a negative NJT and connectivity of the segments, JNT(J), supplied on input cards B.3. Refer to output unit 6 for the values of NFX and NFLX.

5. Subroutine BINPUT: Indicates that the segment number defined by KNT(J) on card B.7 to be an interior segment of a flexible element was not flagged as an interior segment based on the data supplied by JNT(J) on input cards B.3. Check the configuration of the body as specified by the value of JNT(J) and its sign to ensure that segments are to be connected in the desired manner and the flexible element(s) are properly defined. Refer to the message written to output unit 6 for segment at fault.

6. Subroutine VINPUT: Indicates that an improper value has been supplied for MSEG on card C.2. Allowable values are: zero or blank (to represent the primary vehicle); less than or equal to NSEG (to indicate prescribed motion for one of the specified segments); or a value one greater than the value of MSEG supplied on a previous C.2 card (to indicate a new vehicle).

7. Subroutine VINPUT: Indicates that the number of sets of C cards is greater than the maximum allowed (currently 6) or that the total number of segments defined by the program (including the airbags, if any, and the ground) is greater than the maximum allowed (currently 30).

8. Not used.

9. Not used.

10. Subroutine SINPUT: Indicates that the plane identification index (j) is in error on card D.2. They must be supplied as consecutive integers. Refer to the message written to output unit 6 for the plane at fault.

11. Subroutine KINPUT: Indicates that the function number on card E.6 is less than 1 or greater than the maximum allowed (currently 50).

12. Subroutine KINPUT: Indicates that the function number on card E.7 is less than 1 or greater than the maximum allowed (currently 50).

13. Subroutine KINPUT: Indicates that an inconsistent value was supplied for THETAO, on card E.7.

14. Subroutine FINPUT: Indicates that the supplied value for NJ (the first number on the line printed on unit 6) does not correspond to the index j supplied on input cards F.1, F.2, F.3 or F.4.

15. Subroutine FDINIT: Indicates that a function number used on cards F.1, F.2, F.3, F.4 or F.8 has not been defined on input cards E.

16. Subroutine FDINIT: Indicates that the size of the generated TAB array exceeds 4500 or the size of the NTAB array exceeds 1250. These arrays are generated by the functions defined on input cards E and the functions applied on input cards F.

17. Subroutine FINPUT: Indicates that a function number on cards F.5 has not been defined on input cards E.7.

18. Not used.

19. Not used.

20. Subroutine FINPUT: Indicates that the air bag numbers k on cards F.6 have not been supplied in numeric order.

21. Subroutine FINPUT: Indicates that the value of JJ on card F.7.b does not correspond to the index J of the nonzero elements read in on input card F.7.a.

22. Subroutine PLELP: Indicates that the edge-effect option is being used with a hyperellipsoid with unequal powers, on cards F.1.

23. Subroutine SEGSEG: The segment-segment contact is being used with a hyperellipsoid with unequal powers, on cards F.3.

24. Subroutine INITAL: Indicates an input error for IYPR(4,J) on cards G.3. The supplied value is greater than J and less than or equal to NSEG.

25. Subroutine INITAL: Indicates an input error for IYPR(4,J) on cards G.3. The supplied value is negative and does not correspond to NJT(J-1).

26. Subroutine EQUILB: Indicates a problem with input card G.4, G.5 or G.6. The card number and contents in question are printed on logical unit 6.

27. Subroutine EQUILB: Indicates that the iteration for the listed variable did not converge within the specified range, on input cards G.5.

28. Subroutine PLELP: Indicates that the roll-slide constraint is being used with a hyperellipsoid on cards F.1.

29. Subroutine SEGSEG: Indicates that the roll-slide constraint is being used with a hyperellipsoid, on cards F.3.

30. Not used.

31. Subroutine DINT: Indicates that a negative square root has been detected in Subroutine PDAUX with the time step size of H-HMIN. This is usually an indication that extreme angular motion occurred. Unless there are other obvious errors, causing the extreme angular motion, it might be remedied by tightening the angular convergance tests specified by input cards B.6 or by decreasing the value for HMIN on input card A.3.

32. Subroutine AIRBG3: Indicates a logical error in the program.

33. Subroutine IMPULS: Indicates that there were improper arguments to Subroutine IMPULS indicating a program logic error.

34. Subroutine DAUX: Indicates that the value for NJ2 exceeded the array size for RHS and IJK, meaning the size of the system to be solved is too big for the current array dimensions.

35. Subroutine FSMSOL: Indicates that the maximum dimension of 600 for the C array has been exceeded, meaning the size of the system to be solved is too big for the current array dimensions.

36. Function FNTERP: Indicates that improper arguments were passed to the FNTERP function as indicated by the error code as follows:

1 - PHI less than - 180 deg

2 - PHI greater than 180 deg

3 - THETA less than zero deg

4 - THETA greater than 180 deg

37. Subroutine OUTPUT: Indicates that NPRT(4) on input card A.5 was less than or equal to -4 or greater than +4.

38. Subroutine SEGSEG: Indicates that an interior contact is being attempted with a hyperellipsoid, on cards F.3.

39. Subroutine HYLIM: Indicates a computational error in the hyperellipsoid routines.

40. Subroutine HEDING: Indicates that NPRT(4) on input card A.5 was less than or equal to -4 or greater than +4.

41. Subroutine DSMSOL: Indicates that the matrix supplied to Subroutine DSMSOL (by Subroutine IMPLS2, SEGSEG. EDEPTH or INTERS) was singular.

42. Subroutine HBPLAY: Indicates that there was an error in program logic while determining the points that are in play for harness-belt system.

43. Subroutine ROTATE: Indicates that the listed plane number has been assigned to more than one segment. The error can be eliminated by defining multiple identical planes on input Cards D.2 and using different planes assignments on input Cards F.1.

44. Subroutine ROTATE: Indicates that the listed hyperellipsoid number has been assigned to more than one segment on input Cards F.1. The error can be eliminated by defining multiple identical (hyper) ellipsoids on input Cards D.5.

45. Subroutine ROTATE: Same as STOP 44 except that the duplicate assignment was detected on input Cards F.2. Note: Although the duplicate assignment was detected on the indicated input card, the original assignment may have been made on input Cards F.1, F.2, F.3, F.6, F.7 or F.8.

46. Subroutine ROTATE: Same as STOP 44 except that the duplicate assignment was detected for a first segment on input Cards F.3. Note: Although the duplicate assignment was detected on the indicated input card, the original assignment may have been made on input Cards F.1, F.2, F.3, F.6, F.7 or F.8.

47. Subroutine ROTATE: Same as STOP 44 except that the duplicate assignment was detected for a second segment on input Cards F.3. Note: Although the duplicate assignment was detected on the indicated input card, the original assignment may have been made on input Cards F.1, F.2, F.3, F.6, F.7 or F.8.

48. Subroutine ROTATE: Same as STOP 44 except that the duplicate assignment was detected on input card F.7. Note: Although the duplicate assignment was detected on the indicated input card, the original assignment may have been made on input Cards F.1, F.2, F.3, F.6, F.7 or F.8.

49. Not used.

50. Subroutine ROTATE: Same as STOP 44 except that the duplicate assignment was detected on input Cards F.6. Note: Although the duplicate assignment was detected on the indicated input card, the original assignment may have been made on input Cards F.1, F.2, F.3, F.6, F.7 or F.8.

51. Subroutine ROTATE: Same as STOP 44 except that the duplicate assignment was detected on input Cards F.8. Note: Although the duplicate assignment was detected on the indicated input card, the original assignment may have been made on input Cards F.1, F.2, F.3, F.6, F.7 or F.8.

52. Subroutine POSTPR: Indicates that the number of points to be plotted or used to compute the HIC, CSI or HSI number has exceeded the maximum number of points allowed (currently 1000 including time point 0).

53. Subroutine POSTPR: The total number of plot axes has exceeded the maximum (currently 25) and the abscissa is not time.

54. Subroutine POSPR: Indicates that the total number of plot axes has exceeded the maximum (currently 25) and the abscissa is time.

55. Subroutine OUTPUT: Indicates that the reference segment specified for a tabular time history on the H cards does not exist.

56. Subroutine OUTPUT: Indicates that the number of required tabular time histories exceeded the maximum (currently 65). To reduce the number of tabular tim histories, select an appropriate value for NPRT(18) on Card A.5 to eliminate some of the tabular time histories that are automatically outputted and/or reduce the number of tabular time histories requested by the H cards.

57. Subroutine CONTACT: Indicates that the number of plane/segment contacts exceeded the maximum (currently 70). The total number of plane/segment contacts is equal to the sum of the elements of the

MNPL(J) array as specified by Card F.1.a. This sum represents the total number of plane/segment contacts specified for all contact planes.

58. Subroutine HBELT: Indicates that the total number of belts exceeded the maximum (currently 20). The total number of belts consists of the total number of simple belts, NBLT on Card D.1 (maximum currently 8) plus the total number of harness belts, NBLTPH(I) on Card F.8.a (maximum currently 20).

59. Subroutine CONTACT: Indicates that the number of segment-segment contacts on Cards F.3 exceeded the maximum (currently 40).

60. Subroutine HINPUT: Indicates that a preferred direction was not supplied for either an anchor point or a tie-point, on cards F.8.

61. Subroutine HINPUT: Indicates that the specified harness point is either a tie-point or an anchor point but it is allowed to be perturbed along the belt line, i.e. the belt slips instead of the reference point being moved, on Cards F.8.

62. Subroutine HINPUT: Indicates that the reference point is to slide along the belt line and normal to it, but a preferred direction was supplied, on Cards F.8.

63. Subroutine SINPUT: Indicates that the reference number for the contact (hyper)ellipsoid supplied by Card D.5 was greater than the maximum number of contact (hyper)ellipsoids allowed (currently 40).

64. Subroutine SINPUT: Indicates that the reference number for the contact (hyper)ellipsoid supplied by Card D.5 has been assigned to an airbag.

65. Subroutine SINPUT: Indicates that the specified number of contact planes on Cards D.1 exceeds the maximum (currently 30).

66. Subroutine SINPUT: Indicates that the number of specified belts on Card D.1 exceeds the maximum (currently 8).

67. Subroutine SINPUT: Indicates that the number of specified air bags on Card D.1 exceeds the maximum (currently 5).

68. Subroutine SINPUT: Indicates that the number of (hyper)ellipsoids supplied by Cards D.5 exceeded the maximum total number of contact (hyper)ellipsoids (currently 40). Note that this maximum is attainable only if some of the D.5 cards pertain to the contact (hyper)ellipsoids automatically assigned to the segments and given the same number as the segment number. The total number of contact (hyper)ellipsoids, consists of the contact ellipsoids automatically assigned to each segment on the B.2 cards plus any additional ones specified by the D.5 cards.

69. Subroutine SINPUT: Indicates that the number of specified constraints on Card D.1 exceeded the maximum (currently 12). Note that Type 5 constraints (tension elements) are considered as two constraints when computing the total number of constraints.

70. Subroutine SINPUT: Indicates that the number of specified spring dampers on Card D.1 exceeded the maximum (currently 20).

71. Subroutine SINPUT: Indicates that the number of specified harnesses on Card D.1 exceeded the maximum (currently 5).

72. Subroutine SINPUT: Indicates that the number of specified wind force functions on Card D.1 exceeded the maximum (currently 50 if no other force functions are used). If used in conjunction with any other previously defined force function, the total number of force functions and wind force functions cannot exceed the maximum (currently 50).

73. Subroutine SINPUT: Indicates that the number of specified joint functions exceeded on Card D.1 the maximum (currently 50 if no other force functions are used). If used in conjunction with other preceeding

force functions, the total number of force functions including the joint function cannot exceed the maximum (currently 50).

74. Subroutine SINPUT: Indicates that the number of specified force/torque functions on Card D.1 exceeded the maximum (currently 5).

75. Subroutine AIRBG1: Indicates that the total number of segments in the program exceeded the maximum (currently 30). The total number of segments consists of the segments specified by the B.2 cards (NSEG), any vehicle segments (as specified by the C Cards), any airbags (NBAG on Card D.1) and the ground.

76. Subroutine AIRBG1: Indicates that more than 4 contact planes (ellipsoids) were specified for an airbag.

77. Subroutine BINPUT: Indicates that the total number of body segments (NSEG) exceeded the maximum on Card B.1 (currently 28). The total number of body segments must be at most 2 less than the maximum for the total number of segments (currently 30) because there must always be at least 1 vehicle segment and 1 ground segment. If the maximum value for NSEG is used, there can be no airbags or secondary vehicles.

78. Subroutine BINPUT: Indicates that the total number of joints exceeded the maximum (currently 30), on Card B.1.

79. Subroutine VINPUT: Indicates that the total number of points for the unidirectional input (option 2) exceeded the maximum (currently 99), on Cards C.

80. Subroutine VINPUT: Indicates that the total number of points for the 6 degree-of-freedom deceleration input (option 3) exceeded the maximum (currently 501), on Cards C.

81. Subroutine VINPUT: Indicates the total number of actual time points for the spline fit input (option 4) exceeded the maximum (currently 501), on Cards C.

82. Subroutine VINPUT: Indicates that type 1 spline input data were specified but the order of the curve fit was specified to be less than 2, on Cards C.

83. Subroutine VINPUT: Indicates that type 2 spline input data were specified but the order of the curve fit was specified to be less than 1, on Cards C.

84. Subroutine OUTPUT: Indicates that the total number of tabular time histories on Card H.1, H.2 or H.3 has exceeded the maximum (currently 20).

85. Subroutine OUTPUT: Indicates that the total number of tabular time histories on Card H.4, H.5, H.6, H.7 or H.8 has exceeded the maximum (currently 20).

86. Subroutine OUTPUT: Indicates that the number of bodies specified on Card H.10 for which the center-of-mass and related quantities are to be output as tabular time histories has exceeded the maximum (currently 5).

87. Subroutine OUTPUT: Indicates that the number of segments to be included in a body on Cards H.10 has exceeded the maximum (currently 22).

88. Subroutine BELTG: Indicates that the location of the A anchor point of the simple belt (BELT(1,2,3;J), Card D.3.b) was in the interior of the contact ellipsoid to which the simple belt is attached. To avoid this situation, reposition the A anchor point such that the anticipated motion of the contact ellipsoid to which the simple belt is attached will not cause it to come near the location of the A anchor point. Refer to the message written on output unit 6 for the belt at fault.

89. Subroutine BELTG: Indicates that the location of the B anchor point of the simple belt (BELT(4,5,6;J), Card D.3.b) was in the interior of the contact ellipsoid to which the simple belt is attached. To avoid this situation, reposition the B anchor point such that the anticipated motion of the contact ellipsoid to which the simple belt is attached will not cause it to come near the location of the B anchor point. Refer to the message written on output unit 6 for the belt at fault.

90. Not used.

91. Subroutine POSTPR: Indicates that the head injury criteria was requested on Card H.11 with improper values of NPRT(26) and NPRT(30), on Card A.5.

92. Subroutine POSTPR: Indicates that the chest severity index was requested on Card H.11 with improper values of NPRT(26) and NPRT(30), on Card A.5.

93. Subroutine MAINA: The value for NPRT(26) on Card A.5 is greater than 6. Permitted values are -6 through 6.

94. Not used.

95. Not used.

96. Subroutine SINPUT: Indicates that improper values were supplied for segments assigned to be symmetric, on Card D.7.

97. Subroutine SINPUT: Indicates that a segment number supplied for symmetry option on Card D.7 exceeds the number of segments.

98. Not used.

99. Subroutine BINPUT: Indicates that the number of flexible elements exceeds the maximum (currently 8).

100. Subroutine BINPUT: Indicates that the HF array for a flexible element was improperly prescribed, on card B.7.

101. Subroutine BINPUT: Indicates that the value for IDYPR is greater than 3, on Card B.3.

6.0 LOGICAL UNITS ASSOCIATED WITH THE ATB MODEL

Execution of the ATB program requires the use of several FORTRAN input/output files. Except for the primary input and output files (FORTRAN unit Nos. 5 and 6), the use of each I/O file is controlled by input parameters contained within the program input file. It is therefore necessary that the job control stream for a ATB computer run contain those control statements required by the host computer's operating system to access those I/O files that the run may use.

The ATB program, like most FORTRAN programs, requires files to provide for input and output. However, because of the complexity of the ATB model and the potential for huge amounts of output from a single simulation, the ATB program was written so that not all possible files are written out for each run. This tailoring of the number of files to be written for each simulation has been somewhat confusing because some aspects of it are explicit (the user sets a flag for the type and frequency of the desired output) and others are implicit (indirectly determined by the type and number of force deflection interactions, etc).

A logical unit is the device or file from which or to which input or output from a FORTRAN program is to be sent. The READ and WRITE statements of FORTRAN are in the form READ (x,y) where x is the logical unit number and y is the statement number of a FORMAT statement (for formatted types of I/O). This way of dealing with input and output is handy because when the program is compiled it is not required to send output to any specific file, it only sends it to a logical unit. The file that is assigned to that unit can be different each time the program is run, facilitating the use of different input files and correspondingly different output files. It is the job of the operating system (either explicitly by job control statements or implicitly with default file names) to put (create and then assign) files at the addresses of the logical units required for a program every time the program is loaded (taken from disk memory and placed in the computer's memory) and executed (run).

The ATB model has an open-ended number of required logical units which depends on the amount of output requested by parameters in the input file. All computer operating systems, on the other hand, do not have an open-ended number of permitted logical units that can be associated with individual programs (and for that matter all programs being run at a particular time). The actual limit to the number of logical units a particular program can have is a function of the system specification where the user is running the ATB model. Factors that can affect this limit could be the computer type, type of operating system, sysgen parameters for the particular operating system, amount of system space, parameters set when the program was linked, parameters set when the program was compiled, number of jobs in the system when the ATB job is running and their logical unit requirements, size of the disk directory, amount of free disk space and others. If the user experiences problems with the number of logical units and the number of available logical units cannot be increased, the user will have to reduce the number of logical units required for the particular run, usually by changing parameters associated with the tabular time histories.

Table 2 summarizes all of the FORTRAN logical units that may be used by the ATB program.

TABLE 2
Summary of ATB Program I/O Files

LOGICAL UNIT	TYPE*	DESCRIPTION	GENERATING SUBROUTINE	CONTROLLING PARAMETERS
1	U	Program VIEW Input	UNIT1	NRPT(1) on Card A.5
2	F	Printer plots	PRIPLT	NRPT(5,6,7)on Card A.5
3	U	Restart output	RSTART	IRSOUT on Card A.1.a
4	U	Restart input	RSTART	IRSIN on Card A.1.a
5	F	Primary input	several	always required
6	F	Primary output	several	always required
8	U	Time histories	OUTPUT	NPRT(4) on Card A.5
10	U	CALCOMP plots	POSTPR	NPRT(4) on Card A.5
21+	F	Time Histories	OUTPUT	NPRT(4) on Card A.5

* Type is F for formatted, U for unformatted file.

6.1 VIEW OUTPUT (Unit 1)

Logical unit No. 1 is an unformatted (binary) output file designed to be used as input to the VIEW program (Ref. 6), the program that creates the graphics frequently associated with the ATB model. It is generated by Subroutine UNIT1 of the ATB program.

The generation of this output file is controlled by the value of NPRT(1) that is supplied on input Card A.5. A blank or zero value for NPRT(1) will suppress the generation of output file No. 1, whereas a non-zero positive value will produce data records on output file No. 1 that are equally spaced at every m*DT seconds of simulation time starting at 0 time, where m is the integer value of NPRT(1) and DT is defined on input Card A.4.

The first record on output file No. 1 contains fixed initialization data describing the plane and contact ellipsoids, and succeeding records contain the values of time and the c.g. linear coordinates in inertial reference and the direction cosine matrix for each of the body segments. On those computer systems that use double precision computations within the ATB program, the data output on UNIT1 are converted to single precision prior to output.

6.2 PRINTER PLOT OUTPUT (Unit 2)

Logical unit No. 2 is a formatted output file to be printed as optional program output. It contains printer plots generated by Subroutine PRIPLT depicting Y-Z, X-Z and X-Y plane views of the body segments, joints, belts, harness-belts and airbags. Their generation is controlled by the values of NPRT(5, 6 and 7) supplied on input Card A.5 for the Y-Z, X-Z and X-Y plane views, respectively. If any value is zero or blank, the corresponding view will not be generated; if nonzero, the corresponding view will be generated every m*DT seconds, where m is the positive nonzero value of the NPRT indicator and DT is defined on input Card A.4.

These printer plots have also been called "stickman plots". Each view gives the location in the primary vehicle reference coordinate system of the following points:

1. The c.g. position of each body segment using the plot symbols defined by CGS(I) for I = 1 to NSEG as supplied on input Cards B.2.

2. Each joint position using the plot symbols defined by JS(J) for J = 1 to NJNT as supplied on input Cards B.3.

> NOTE: It has been found to be much easier to visualize the printer plots by supplying values for CGS and JS variables for each of the "standard" 15 segments as depicted in Table 3.

TABLE 3

Suggested Printer Plot Symbols

segment or joint	H -HP - N -NP -UT - W -CT - P -LT
CGS or JS	1 - 2 - 3 - 4 - 5 - 6 - 7 - 8 - 9
segment or joint	RH -RUL-RK -RLL-RA -RF
CGS or JS	A - B - C - D - E - F
segment or joint	LH -LUL-LK -LLL-LA -LF
CGS or JS	I - J - K - L - M - N
segment or joint	RS -RUA-RE -RLA
CGS or JS	P - Q - R - S
segment or joint	LS -LUA-LE -LLA
CGS or JS	W - X - Y - Z

3. The anchor points, tangent points and fixed point for each belt using the plot symbol".".

4. Each point in play for the harness-belt systems using the plot symbol ".".

5. The center and semiaxes endpoints for each airbag using the plot symbols "@" for the center, "-" for the endpoints of the Z axis and "I" for the endpoints of the X and Y axes.

6. The origin of the vehicle reference coordinate system using the plot symbol "*". This origin (in X, Y, and Z plot coordinates) is specified by the values of ZPLT on input Card G.1.a, all plotted points are translated with respect to this origin, and those plot coordinates falling outside of the plotting area (1 to 120 for the plot Z axis, and 1 to 60 for the plot X and Y axes) are ignored.

The printed output pages produced from FORTRAN output No. 2 consist of 60 lines of 120 characters each. In general, the first or top line represents the plot Z axis and the first column or the left side edge, running from top to bottom, represents the plot X axis. If

the view contains the plot Y axis, it is used in place of the unused X or Z axis. By rotating the printed pages 90 degrees in a counter-clockwise direction, the printed page becomes more familiarly orientated, i.e., negative Z up and positive X to the right from the lower left corner. The first character of each line is filled with the symbol "-" that serves as tick marks along the positive plot X axis. The distance between each of these tick marks is one length unit (UNITL on input Card A.3.) Distances or lengths in the plot Z direction are the same and are established by the supplied values of SPLT on input Card G.1.b. to accomodate printers that differ from default values of 10 horizontal characters and 6 lines per inch.

6.3 RESTART INPUT AND OUTPUT (Units 3 and 4)

The ATB program has a built-in optional restart procedure that is versatile and independent of the computer and operating system being used. This option allows a simulation to be made as a base run, then program parameters can be changed and the simulation continued, as a restart run.

To use the restart procedure, the following steps must be followed:

1) Any computer simulation run (including a restart run itself) may be a base run by defining the restart output unit IRSOUT = 3 on card A.1.A.

2) To restart the base run, define the restart input unit as IRSIN = 4 and the restart time (RSTIME) on card A.1.A. and redefine the data and run description on cards A.1.A–A.1.C.

3) Program parameters are modified on cards A.2 which permit the user to change any variables in the program labeled common blocks. No further input is required for the restart run.

4) For the restart run, the program is loaded into the computer as normal. However, the user must properly assign the restart input and output units.

To use the restart procedure, the user should be aware of the following procedures, considerations and restrictions.

1) The procedure consists of two subroutines (RSTART and SEARCH called by the main program) written entirely in FORTRAN IV and is therefore completely independent of the computer and operating system being used.

2) The restart procedure is completely optional. Its use is controlled by three additional input parameters on the first input card in such a manner that blank or zero values deactivate the procedure. This permits its optional use without disturbing the organization of current input decks.

3) Any computer simulation can be made a base run by setting IRSOUT = 3 on card A.1.A. This defines the restart output unit as 3 and requires that the logical unit 3 be assigned to a file.

4) During execution of the base run, an initial record is written on the restart output unit containing all the information in the program labeled common blocks that were defined by the input and initialization portions of the program.

5) At equally spaced simulation time intervals (DT as specified on card A.4), when the integration returns control to the main program to perform optional output, time point records are written on the restart output unit. These records contain all information in the program's labeled common blocks that are time dependent and/or necessary to restart the program. The writing of the restart unit in no way disturbs the normal operation of the computer simulation.

6) To restart, the program is reloaded in the normal manner (program changes since the base run are permissible if the changes did not affect the format and contents of the restart unit.) Input cards A.1.A, A.1.B and A.1.C are required defining a new date, run description, the restart input unit number (IRSIN, a value of 4 is suggested) and the restart time (RSTIME, an integral multiple of DT). IRSOUT may be defined, if desired, to generate an additional restart output unit. Again make sure the proper control statements are included for units IRSIN and IRSOUT.

7) The program reads the initial input record from the restart input unit described in step 4. The program then bypasses the remainder of the input and initialization steps. One set of A.2 cards are then processed to modify any of the input or initialization data from the base run that is to apply to the new run. If the new value of IRSOUT is non-zero, step 4 is repeated for the new restart output unit with the input modifications, if any.

8) The program then advances the computer simulation time in DT increments by reading the restart input unit records, instead of calling the integrating routine DINT, up to and including the restart time RSTIME. After each step, the main program performs any optional output that is required including writing the time point record onto the new restart output unit, if required. In addition, the restart procedure calls Subroutine OUTPUT at each DT time increment to write a line of output on all the time history output units, thereby producing abbreviated time histories prior to the resumption of normal operation.

9) Immediately preceeding the resumption of normal operation at the restart time RSTIME, the second set of A.2 input cards is read allowing the user to change any variable in the labeled common blocks to be used by the program during the succeeding normal operation of the program.

10) All variable modifications are made through the use of the input cards A.2. Two sets (each terminated by a blank card) are processed, the first after the input record is read from the restart input time, and the second just prior to resumption of normal operation of the program. Through the use of these cards, the user has the capability of changing any variable in the program labeled common blocks. The program merely makes the changes indicated by the user and no attempt is made to check the validity or consistency of the modifications. Variables that are useful to change include:

1. NSTEPS, DT, to control the length of the run.
2. Elements of NPRT array, to control optional output.
3. HMIN,HMAX,NDINT,SGTEST, to control the integrator.
4. Variables that define the position and characteristics of the planes and other contact devices.

Some variable modifications should not be made including:

1. Modifications that would cause abrupt discontinuities in the integration procedure.
2. Geometrical dimensions of the body segments and joints used to compute segment positions by the CHAIN procedure.
3. Controls of contacts, constraints that are currently active.
4. Control of force deflection characteristic functions that are currently loading or reloading.

In general, the user should carefully evaluate the potential effects of restart modifications before prescribing them.

6.4 STANDARD INPUT (Unit 5)

The standard input file for the ATB program is logical unit No. 5. It contains all the required input for a standard ATB simulation and is described in detail in Section 4.0.

6.5 PRIMARY OUTPUT (Unit 6)

The primary output file for the ATB program is logical unit No. 6. It contains the following items:

1. A labelled echo of the ATB program input data.

2. Subroutine PRINT produces tables of segment linear and angular position information, joint forces and torques, the sum of all external forces and torques acting on each segment, and constraint forces data. These data are generated by the main program at fixed time intervals of m*DT seconds, where m is the value of NPRT(3) supplied on input Card A.5 and DT on input Card A.4, and by other subroutines for diagnostic purposes. In general, these tables are not as useful as the tabular time histories (to be discussed later), and their generation may be completely suppressed by setting NPRT(3) equal to zero on input Card A.5.

3. Tables of the computer elapsed CPU time used by selected subroutines and the number of calls to these subroutines are generated by Subroutine ELTIME. They are printed at fixed time intervals as specified by DT on input Card A.4 at a frequency specified by NPRT(2). When NPRT(2) is zero the table is generated only once at the successful completion of a run of the ATB program.

4. Diagnostic type output is produced at every call to various subroutines as controlled by the values supplied for NPRT(8) to (28) on input Card A.5. This output is intended for diagnostic or checkout purposes only, and, if used indiscriminately, can produce voluminous amounts of output. This output is not always completely annotated and the user should refer to the listing of the subroutine involved for a description of the variables printed.

5. Short descriptions of changes in some of the conditions of a ATB run are produced as they occur. They include:

a. Failures of the convergence tests for the program integrator that cause the integration step to decrease in size. The time, step size, segment and test involved, and the final convergence test parameters are printed. NOTE: These messages are normal and do not indicate an error in the simulation. A stop will occur if the integration step becomes too small.

b. Changes in the lock conditions of joints as detected by changes in the values of IPIN or IEULER for the various joints. The time, previous and new values of the indicator, and the identification number of nomenclature of the joint involved are printed.

c. Changes in the set of contact points in play for the harness-belt systems are indicated by listing the time, the set of points and the distance between them at each time a point is added to or deleted from the set of points.

6. A page containing values of the head injury criterion (HIC), head and chest severity indices (HSI and CSI) and related information is produced under the following conditions:

a. The tabular time histories are produced on output file no. 8 (see below) by supplying a nonzero value for NPRT(4) on input Card A.5.

b. Accelerations for the head and chest are generated on the tabular time histories as specified on input Cards H.1.

c. Either JDTPTS(1) or (2) is nonzero as specified on input Card H.11.

7. The tabular time histories may be generated on the primary output file as described in the next section.

6.6 TABULAR TIME HISTORIES (Units 6 and 8, or 21, 22, 23,...)

The tabular time histories are perhaps the most useful output of the ATB program. Their generation, contents, frequency of output and the manner by which they are generated are completely controlled by program input parameters.

6.6.1 Control of Types of Tabular Time History Pages

The tabular time histories are generated by Subroutine OUTPUT. The type and format of data produced is controlled by program input as follows:

6.6.1.1 Optional Pages Controlled By Input Cards H.1 to H.10. The output of the optional time histories is controlled by Cards H.1 to H.10.

a. Output of the components and resultant of linear accelerations for points on segments is specified by input Cards H.1. These tables are printed out with three time histories per page.

b. Output of the components and resultant of linear velocities for points on segments is specified by input Cards H.2. These tables are printed out with three time histories per page.

c. Output of the components and resultant of linear positions for points on segments is specified by input Cards H.3. These tables are printed out with three time histories per page.

d. Output of the components and resultant of angular acceleration for segments is specified by input Cards H.4. These tables are printed out with three time histories per page.

e. Output of the components and resultant of angular velocities for segments is specified by input Cards H.5. These tables are printed out with three time histories per page.

f. Output of the components (yaw, pitch and roll) and resultant of angular rotations for segments is specified by input Cards H.6. These tables are printed out with three time histories per page.

g. Output of the lock condition, angles and resistive torques for joints is specified by input Cards H.7. These tables are printed out with two time histories per page.

h. Output of the components and resultant of the wind forces on segments is specified by input Card H.8. These tables printed out with three time histories per page.

i. Output of the components of the forces and torques transferred across the joints is specified by input Card H.9. These tables are printed out with one time history per page.

j. Output of the center of gravity location, linear and angular momentum, and kinetic energy of sets of segments (bodies) is specified by input Card H.10. These tables are printed out with one time history per page.

6.6.1.2 Results of Forces Generated For Allowed Contacts. The output of these time histories is controlled by NPRT(18) on input Card A.5.

a. Output of contact forces data for the allowed contacts between planes and segments is specified by input Cards F.1. These tables contain two plane - segment contact time histories per page.

b. Output of strain and anchor point forces for each allowed contact between belts and segments is specified by input Cards F.2. These tables contain two belt - segment contact time histories per page.

c. Output of strain and endpoint forces for all belt sections of the harness belt systems from the points specified as endpoints is specified by input Cards F.8.d. These tables contain two belt section time histories per page.

d. Output of the results of spring damper forces is specified by input Cards D.8. These tables contain two spring damper time histories per page.

e. Output of contact forces data for the allowed contacts between segments is specified by input Cards F.3. These tables contain one segment - segment contact time history per page.

f. Output of the airbag parameters and contact forces for the allowed contacts between airbags and segments is specified by input Cards F.6. These tables contain four airbag - segment contact time histories per page.

6.6.2 Methods of Generating the Tabular Time Histories

The ATB program contains two methods that may be used to generate the tabular time histories. These are controlled by the value supplied for NPRT(4) on input Card A.5.

6.6.2.1 Multiple Secondary Output Files (Units 21, 22, 23,...). The first method (NPRT(4) = 0, 1 or 4) causes Subroutines OUTPUT and HEDING to produce the tabular time histories on multiple secondary output files, commencing with logical unit No. 21 and using up to 65 consecutive unit numbers as required by the program input, with each new page type (as described in the previous section) assigned to the next higher logical unit number. This method requires control statements be included in the ATB program input stream to assign and print these multiple secondary output files as required by the host computer system. The maximum number of these multiple secondary files can be increased by changing the Stop in subroutine OUTPUT.

The first page generated in the sequence described above will be assigned to logical unit No. 21 and identified as page 21.01. As new page types are required, they will be assigned to logical unit Nos. 22, 23, etc. with the first printed page on each unit identified as page 22.01, 23.01, etc. The heading on each printed page contains this page identification in the upper right corner, followed by lines containing the date (DATE from input Card A.1.a), run description (COMENT from input Cards A.1.b and c), the vehicle deceleration (VPSTTL from input Card C.1), crash victim identification (BDYTTL from input Card B.1), and a completely annotated description of the tabular columns contained on each page.

The first column of each line on every file contains the value of TIME (msec). Each individual page on each file contains 45 lines of tabular data. Each page is numbered with a unique identification of the form NT.XX where NT is the logical unit number and .XX is a decimal number commencing with .01 and incremented by .01 for subsequent pages of each file. Each page contains the complete heading information described in

the previous paragraph. Therefore, the pages from the different NT files and with the same .XX identifier, contain the tabular time history data for the same time points.

The frequency of the printed lines of output on each file or page of the tabular time histories is controlled by the supplied value of NPRT(26) on input Card A.5.

6.6.2.2 Post-Processing Time History Data File (Units 6 and 8). The data generated for the tabular time histories by Subroutine OUTPUT can be transmitted to an unformatted output file (logical unit no. 8) designed to serve as an input file for the post-processing features available in the ATB program. The generation of this time history output file and its use by the post-processing features is controlled by the value of NPRT(4) supplied on input Card A.5 as follows:

a. NPRT(4) = 0 (default): The time history file (logical unit no. 8) is not created or accessed and the tabular time histories are produced on the multiple secondary output files as described above.

b. NPRT(4) = 1, . . . , 4: The time history file is generated as an unformatted output file (logical unit no. 8) by Subroutine OUTPUT during the integration process portion of the ATB program. The frequency of data stored on the time history file is controlled by the supplied value for NPRT(26) on input Card A.5 and is identical to the use of NPRT(26) described above for the multiple secondary output files. At the end of the run, the main program writes an end-of-file on the time history file, rewinds it, and then calls Subroutine POSTPR, which now uses the time history file as an input file to perform the required post-processing operations. Note that Subroutine POSTPR is not called for NPRT(4) = 4, this value operates essentially the same as for NPRT(4) = 0 except that a time history file

(logical unit no. 8) is generated for possible use by subsequent ATB runs.

c. NPRT(4) = -1, -2, or -3: The time history file that was generated during a previous run is used as an input file for the post-processing operations (Subroutine POSTPR) of the current ATB run. In this case, the main program processes input Cards A.1 to A.5, bypasses the other input routines (input Cards B.1 to H.10) and integration process, and transfers to the end of the main program to call Subroutine POSTPR to perform the post-processing operations, using the time history file (logical unit no. 8) from a previous run.

d. NPRT(4) = plus or minus 2 or 3: The tabular time histories will be produced on the primary output file (logical unit no.6) by Subroutines POSTPR and HEDING from the time history input file (logical unit no. 8) during the post-processing operations performed at the end of a ATB run. The tabular time histories produced by this method will be identical to those described for the multiple secondary output files above, except for the following conditions:

(1) The output will be produced from single precision words rather than from double precision words except on those computer (CDC or Cyber) systems that do not require double precision computations for the ATB program. This means that any exponential formats will print with an E rather than with a D format.

(2) The individual pages will be ordered by time and not by file numbers, i.e., the page number sequence here will be 21.01, 22.01, 23.01, ...; 21.02, 22.02, 23.02, ...; 21.03, 22.03, 23.03, ...etc., rather than the sequence 21.01, 21.02, 21.03 ...; 22.01, 22.02, 22.03, ...; 23.01, 23.02, 23.03, ...etc. that is produced from the multiple secondary output files.

(3) The use of NPRT(26) = 2 to control the frequency of the printed lines will not be operational unless it was also used to generate the time history file (logical unit no. 8).

e. NPRT(4) = plus or minus 1 or 3: Calcomp plots of data from the tabular time histories will be generated during the post-processing operations performed by Subroutine POSTPR at the end of an ATB run. These are discussed in more detail in the following section.

6.7 CALCOMP PLOT OUTPUT (Unit 10)

One of the post-processing operations available in the ATB program is the capability to generate Calcomp plots from the data contained on the time history file (logical unit no. 8). The generation of these plots is controlled by supplying an odd value (plus or minus 1 or 3) for NPRT(4) on input card A.5; a positive value indicates the plots will be generated during the same run that computed the time history data, while a negative value indicates the plots will be generated from the time history file of a previous run; a magnitude of one indicates that only the plots will be generated while a magnitude of three indicates that the printed tabular time histories will also be generated on the primary output file (logical unit no. 6). Although Table 2 lists logical unit no. 10 as the Calcomp plot output file, the actual file assignment, the control statements required in the ATB program job control stream and the procedures for the actual generation of the Calcomp plots from the Calcomp plot output file are a function of the host computer system.

The Calcomp plots are completely general in nature, with the general format, page and plot size, and the variables to be plotted supplied as program input. The capability is available to plot, as a function of any variable, any other variables that are listed in the tabular time histories from the data stored on the time history file (logical unit no. 8). The complete specifications for each plot are supplied on input Cards I.1 to I.8, following input Card H.11. of the ATB program input file. Seven input cards are required for each plot to specify:

1. The number of plots to be generated.

2. The number of dependent (Y) variables to be plotted against the same independent (X) variable on each plot.

3. The page number and column number (from the printed tabular time histories) for each of the dependent (Y) variables and the independent (X) variable for each plot.

4. For both the horizontal (X) and vertical (Y) axes of each plot;

   a. the number of intervals or decrements along the axis,

   b. an indicator to specify a linear or logarithmic axis.

   c. the values at the origin and end of the axis,

   d. the length of the axis and of the paper or page size in the direction of the axis, and

   e. the number of characters and the alphanumeric information for the label of each axis.

5. The number of characters and the alphanumeric information for each of two lines of a plot label to appear below the X axis label.

For a complete description of the required input parameters for the Calcomp plots, the user should refer to the input description for input Cards I.1 to I.8 contained in Section 4.0. In addition to plotting any variables from the tabular time histories against time, examples of other types of plots that have been generated include X-Z plots of the head C.G. positions and plots of force vs. deflection (or strain) that depict the actual loading and unloading characteristics that were experienced. Since it is possible to specify the size and scaling for each axis, plots may be generated for comparison with available experimental data.

The frequency of the data points for plotting is controlled by NPRT(30) on Card A.5. This frequency cannot be greater than the data stored in output Unit 8 as specified by NPRT(26).

APPENDIX A

SLED TEST EXAMPLE

This example ATB input and output is from a typical sled test simulation. It contains a 15 segment body restrained with a harness belt. A hyperellipsoid is used to represent the dash.

```
2 SEPT 1988    0   0     0.0                                                   CARD A1A
EXAMPLE 1:  BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD
 IN. LB.SEC.           0.0          0.0       386.088          0.0             CARD A3
   4  40    0.002  0.0005    0.001.0000625                                     CARD A4
 1 040 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1CARD A5
    15    14         95TH PERCENTILE MALE                                      CARD B1
 LT  134.7721.62801.01011.7954 5.168 7.436 3.778 0.000 0.000-0.072   0  CARD B2A
 CT  213.0990.41600.23010.5857 4.809 6.673 4.145 0.000 0.000-0.011   0  CARD B2A
 UT  353.6733.45252.78322.3509 5.220 6.906 7.314 0.000 0.000-0.872   0  CARD B2A
 N   4 3.2890.02780.02780.0216 2.520 2.520 3.156 0.000 0.000 0.000   0  CARD B2A
 H   511.9270.27080.30850.1584 3.984 3.125 5.836 0.000 0.000 0.000   0  CARD B2A
 RUL 622.7252.01302.01300.2576 3.308 3.30812.652 0.000 0.000 0.000   0  CARD B2A
 RLL 7 9.7630.49890.49890.0626 2.487 2.487 9.616 0.000 0.000 0.000   0  CARD B2A
 RF  8 2.0790.04260.04120.0055 2.866 2.016 5.617 0.000 0.000 1.462   0  CARD B2A
 LUL 922.7252.01302.01300.2576 3.308 3.30812.652 0.000 0.000 0.000   0  CARD B2A
 LLL A 9.7630.49890.49890.0626 2.487 2.487 9.616 0.000 0.000 0.000   0  CARD B2A
 LF  B 2.0790.04260.04120.0055 2.866 2.016 5.617 0.000 0.000 1.462   0  CARD B2A
 RUA C 5.5420.17430.17430.0259 2.122 2.122 7.497 0.000 0.000 0.000   0  CARD B2A
 RLA D 5.9010.33310.33310.0214 1.871 1.87110.269 0.000 0.000 0.000   0  CARD B2A
 LUA E 5.5420.17430.17430.0259 2.122 2.122 7.497 0.000 0.000 0.000   0  CARD B2A
 LLA F 5.9010.33310.33310.0214 1.871 1.87110.269 0.000 0.000 0.000   0  CARD B2A
  P  M    1    0  0.00   0.00 -3.85  0.00   0.00  1.61                     CARD B3A
                  0.00   0.00  0.00  0.00   5.00  0.00
  W  N    2    0  0.00   0.00 -1.64  0.00   0.00  6.44                     CARD B3A
                  0.00   0.00  0.00  0.00   5.00  0.00
  NP O    3    0  0.00   0.00 -8.19  0.00   0.00  0.64                     CARD B3A
                  0.00   0.00  0.00  0.00  10.00  0.00
  HP P    4    0  0.00   0.00 -0.64  0.00   0.00  5.84                     CARD B3A
                  0.00   0.00  0.00  0.00  10.00  0.00
  RH Q    1    0  0.00   3.42 -0.31  0.00   0.00 -8.64                     CARD B3A
                  0.00   0.00  0.00  0.00-45.00  0.00
  RK R    6    1  0.00   0.00 10.00  0.00   0.00 -6.97                     CARD B3A
                  0.00   0.00  0.00  0.00  60.00  0.00
  RA S    7    0  0.00   0.00  8.12  2.87   0.00 -2.66                     CARD B3A
                  0.00  90.00  0.00  0.00  10.00  0.00
  LH T    1    0  0.00  -3.42 -0.31  0.00   0.00 -8.64                     CARD B3A
                  0.00   0.00  0.00  0.00-45.00  0.00
  LK U    9    1  0.00   0.00 10.00  0.00   0.00 -6.97                     CARD B3A
                  0.00   0.00  0.00  0.00  60.00  0.00
  LA V   10    0  0.00   0.00  8.12  2.87   0.00 -2.66                     CARD B3A
                  0.00  90.00  0.00  0.00  10.00  0.00
  RS W    3    0  0.00   6.24 -5.22  0.00   0.00 -5.37                     CARD B3A
                  0.00   0.00  0.00  0.00  -4.10  0.00
  RE X   12    1  0.00   0.00  5.42  0.00   0.00 -8.20                     CARD B3A
                  0.00   0.00  0.00  0.00-70.00  0.00
  LS Y    3    0  0.00  -6.24 -5.22  0.00   0.00 -5.37                     CARD B3A
                  0.00   0.00  0.00  0.00  -4.10  0.00
  LE Z   14    1  0.00   0.00  5.42  0.00   0.00 -8.20                     CARD B3A
                  0.00   0.00  0.00  0.00-70.00  0.00
```

```
.000 10.00   .00  0.70      20.000  .000 10.00   .00  0.70       5.000CARD B4
.000 10.00   .00  0.70      20.000  .000 10.00   .00  0.70      35.000CARD B4
.000  5.00   .00  0.70      25.000  .000 10.00   .00  0.70      35.00 CARD B4
.000  5.00   .00  0.70      25.000  .000 10.00   .00  0.70      35.00 CARD B4
.000 10.00   .00  0.70      70.000  .000  .800   .00  0.70      40.00 CARD B4
.000  1.80   .00  0.70      60.000  .000  .000   .00   .00        .00 CARD B4
.000  7.00   .00  0.70      35.000  .000 10.00   .00  0.70      26.00 CARD B4
.000 10.00   .00  0.70      70.000  .000  .800   .00  0.70      40.000CARD B4
.000  1.80   .00  0.70      60.000  .000  .000   .00   .00        .00 CARD B4
.000  7.00   .00  0.70      35.000  .000 10.00   .00  0.70      26.00 CARD B4
.000 10.00   .00  0.70     122.500  .000 10.00   .00  0.70      65.00 CARD B4
.000  1.80   .00  0.70      70.000  .000   .00   .00   .00        .00 CARD B4
.000 10.00   .00  0.70     122.500  .000 10.00   .00  0.70      65.00 CARD B4
.000  1.80   .00  0.70      70.000  .000   .00   .00   .00        .00 CARD B4
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  0.1   0.0  30.0   0.0   0.0                    0.0   0.0            CARD B5
  .01   .01   .01   .01   .01   .01   .10   .10   .10   .10   .10   .01CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
  .01   .01   .01   .00   .00   .00   .10   .10   .10   .00   .00   .00CARD B6
SLED ACCELERATION - 20G PEAK
  0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0    15   0.0 0.010     0CARD C2A
  0.0   5.0  10.0  15.0  20.0  15.0  10.0   5.0   0.0   0.0   0.0   0.0CARD C3
  0.0   0.0   0.0                                                       CARD C3
   12     0     0     3     0     0     1     0     0     0             CARD D1
  1    SEAT. 6 DEGREE OFF HORIZONTAL.                                   CARD D2A
       10.0        8.0        -10.0                                     CARD D2B
```

```
      28.01        8.0      -11.89                                          CARD D2C
      10.0        -8.0      -10.0                                           CARD D2D
  2   BACK PANEL.  13 DEGREE OFF VERTICAL.                                  CARD D2A
      1.0          9.0      -48.97                                          CARD D2B
      10.0         9.0      -10.0                                           CARD D2C
      1.0         -9.0      -48.97                                          CARD D2D
  3   FLOOR.                                                                CARD D2A
      0.0         12.0       -1.3                                           CARD D2B
      60.0        12.0       -1.3                                           CARD D2C
      0.0        -12.0       -1.3                                           CARD D2D
  4   HEAD PAD. 13 DEGR                                                     CARD D2A
      2.48         7.5      -47.26                                          CARD D2B
      4.96         7.5      -36.55                                          CARD D2C
      2.48        -7.5      -47.26                                          CARD D2D
  5   SEAT FRONT PANEL.                                                     CARD D2A
      28.01        8.0      -11.89                                          CARD D2B
      26.66        8.0       -4.40                                          CARD D2C
      28.01       -8.0      -11.89                                          CARD D2D
  6   BACK PANEL2. 13 DEGREE OFF VERTICAL.                                  CARD D2A
      1.0          9.0      -48.97                                          CARD D2B
      10.0         9.0      -10.0                                           CARD D2C
      1.0         -9.0      -48.97                                          CARD D2D
  7   FIREWALL.                                                             CARD D2A
      60.0        12.0      -25.0                                           CARD D2B
      60.0       -12.0      -25.0                                           CARD D2C
      60.0        12.0      -0.75                                           CARD D2D
  8   RIGHT SIDE SEAT/IN.                                                   CARD D2A
      8.41         8.1      -6.66                                           CARD D2B
      8.70         8.1      -14.73                                          CARD D2C
      30.58        8.1      -6.64                                           CARD D2D
  9   LEFT SIDE SEAT/IN.                                                    CARD D2A
      8.41        -8.1      -6.66                                           CARD D2B
      30.58       -8.1      -6.64                                           CARD D2C
      8.70        -8.1      -14.73                                          CARD D2D
 10   RUDDER PEDALS.                                                        CARD D2A
     49.992        9.0   -2.239222                                          CARD D2B
     52.992        9.0  -4.7565222                                          CARD D2C
     49.992       -9.0   -2.239222                                          CARD D2D
 11   LEFT SIDE PANEL.                                                      CARD D2A
      1.0         -9.0      -48.97                                          CARD D2B
      10.9        -9.0      -6.10                                           CARD D2C
     -7.77        -9.0      -46.95                                          CARD D2D
 12   RIGHT SIDE PANEL.                                                     CARD D2A
      1.0          9.0      -48.97                                          CARD D2B
     -7.77         9.0      -46.95                                          CARD D2C
      10.9         9.0      -6.10                                           CARD D2D
  22  4.5   3.0   3.0   0.0   4.0   -3.5   0.0   0.0   0.0                  CARD D5
  23  3.2   6.0   8.0   0.0   0.0   -7.0   0.0   0.0   0.0                  CARD D5
  24  6.0  15.0   5.0  38.0   0.0  -28.0   0.0   0.0   0.0  20.  20.  20.CARD D5
 0   0   0   0   0   0   0   0   0   0   0   0   0   0   0                  CARD D7
```

```
 3    SEGMENT-SEGMENT FCN.                                              CARD E1
        0.0        -5.0         0.0         0.0         1.0             CARD E2
   6                                                                    CARD E4A
        0.0         0.0         1.0       470.0         2.0        890.0CARD E4B
        3.0      1220.0         4.0      1470.0         5.0       1580.0CARD E4B
 6    CONSTANT, F=0.0                                                   CARD E1
        0.0         0.0         0.0         0.0         0.0             CARD E2
 7    R FACTOR.                                                         CARD E1
        0.0         0.0         0.7         0.0         0.0             CARD E2
13    STIFF SURFACES                                                    CARD E1
        0.0        -4.0         0.0         0.0         1.0             CARD E2
   8                                                                    CARD E4A
        0.0         0.0         0.1         5.0         0.2         20.0CARD E4B
        0.3        40.0         0.4        60.0         1.0        860.0CARD E4B
        2.0      2400.0         3.0      4000.0                         CARD E4B
14    FRICTION FUNC.                                                    CARD E1
        0.0         0.0         0.5         0.0         1.0             CARD E2
19    CF=.25,CREST=.25                                                  CARD E1
        0.0         0.0        0.25         0.0         0.0             CARD E2
20    DAMPING COEFF. C=900                                              CARD E1
        0.0        1.00         0.0         0.0         1.0             CARD E2
        0.0       900.0         0.0         0.0         0.0          0.0CARD E3
21    RATE OF DEFLEC.                                                   CARD E1
      -40.0     -150.00         0.0         0.0         1.0             CARD E2
  21                                                                    CARD E4A
      -40.0       0.000       -30.0       0.000       -20.0        0.000CARD E4B
      -10.0       0.000         0.0       0.000         5.0        1.000CARD E4B
       10.0       1.000        20.0       0.990        30.0        0.965CARD E4B
       40.0       0.928        50.0       0.860        60.0        0.690CARD E4B
       70.0       0.475        80.0       0.340        90.0        0.260CARD E4B
      100.0       0.200       110.0       0.180       120.0        0.090CARD E4B
      130.0       0.060       140.0       0.025       150.0        0.000CARD E4B
22    DAMPING COEFF. C=35                                               CARD E1
        0.0        1.00         0.0         0.0         1.0             CARD E2
        0.0        35.0         0.0         0.0         0.0          0.0CARD E3
24    DAMPING COEFF. C=0.8                                              CARD E1
    -1000.0     -1000.0         0.0         0.0         1.0             CARD E2
   4                                                                    CARD E4A
    -1000.0         0.6        -1.0         0.6         0.0          1.0CARD E4B
     1000.0         1.0                                                 CARD E4B
25    DAMPING COEFF C=1100                                              CARD E1
        0.0        1.00         0.0         0.0         1.0             CARD E2
        0.0      1100.0         0.0         0.0         0.0          0.0CARD E3
26    STIFF SURFACES-LL                                                 CARD E1
        0.0        -4.0         0.0         0.0         1.0             CARD E2
   8                                                                    CARD E4A
        0.0         0.0         0.1         5.0         0.2         20.0CARD E4B
        0.3        40.0         0.4        60.0         2.0        860.0CARD E4B
        3.0      2400.0         4.0      4000.0                         CARD E4B
31    HARNESS FDF                                                       CARD E1
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        0.0        -4.0          0.0          0.0          0.0          0.0CARD E2
    8                                                                      CARD E4A
        0.0         0.0         0.01        150.0         0.02        300.0CARD E4B
       0.03       450.0         0.05        850.0         0.10       3500.0CARD E4B
       1.00     35000.0         4.00     140000.0                          CARD E4B
  32   HARNESS FRICTION                                                    CARD E1
        0.0         0.0          0.2          0.0          0.2             CARD E2
  34   HARNESS FRICTION                                                    CARD E1
        0.0         0.0          0.9          0.0          0.2             CARD E2
9999                                                                       CARD E1
   3   3   2   1   0   0   0   0   0   2   0   0                           CARD F1A
   1  16   1   1  13 -20 -21   0  14   1                                   CARD F1B
   1  16   6   6  13 -25 -21   0  14   1                                   CARD F1B
   1  16   9   9  13 -25 -21   0  14   1                                   CARD F1B
   2  16   1   1  13 -20 -21   0  14   1                                   CARD F1B
   2  16   2   2  13 -20 -21   0  14   1                                   CARD F1B
   2  16   3   3  13 -20 -21   0  14   1                                   CARD F1B
   3  16   8   8  13 -22 -21   0  14  -1                                   CARD F1B
   3  16  11  11  13 -22 -21   0  14  -1                                   CARD F1B
   4  16   5   5  13 -22 -21   0  14   1                                   CARD F1B
  10  16   8   8  13 -22 -21   0  14   1                                   CARD F1B
  10  16  11  11  13 -22 -21   0  14   1                                   CARD F1B
   0   2   0   0   0   1   0   0   1   0   0   0   1   0   1               CARD F3A
   2   2  13  13   3   0   7   0  19                                       CARD F3B
   2   2  15  15   3   0   7   0  19                                       CARD F3B
   6   6  13  13   3   0   7   0  19                                       CARD F3B
   9   9  15  15   3   0   7   0  19                                       CARD F3B
  13  13  16  24  13 -22 -21   0  14                                       CARD F3B
  15  15  16  24  13 -22 -21   0  14                                       CARD F3B
   0   0   0   0   0   0   0   0   0   0   0   0   0   0                   CARD F4A
   2                                                                       CARD F8A
  12  15                                                                   CARD F8B
  31   0   0   0   0          0.0                                          CARD F8C
  16   0   1   1   0   0   0   0   0       13.000          8.0      -10.300CRD F8D1
                                              2.4         22.0         -0.3CRD F8D2
   1   1   0   1   0   0   0   0  34       -1.178        7.075       -0.781CRD F8D1
                                                                           CRD F8D2
   1   1   0   1   0   0   0   0  34       -0.029        6.796       -1.534CRD F8D1
                                                                           CRD F8D2
   1   1   0   1   0   0   0   0  34        0.910        5.778       -2.283CRD F8D1
                                                                           CRD F8D2
   1   1   0   1   0   0   0   0  34        2.228        2.355       -3.192CRD F8D1
                                                                           CRD F8D2
   1  23   0   1   0   0   0   0   0        2.957         0.00        3.059CRD F8D1
                                                                           CRD F8D2
   1   1   0   1   0   0   0   0  34         3.07         -.08        -4.41CRD F8D1
                                                                           CRD F8D2
   1   1   0   1   0   0   0   0  34        1.785       -2.325       -3.343CRD F8D1
                                                                           CRD F8D2
   1   1   0   1   0   0   0   0  34        0.011       -5.145       -2.728CRD F8D1
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                                                                CRD F8D2
 1   1   0   1   0   0   0   0  34     -0.880     -5.789     -2.282CRD F8D1
                                                                CRD F8D2
 1   1   0   1   0   0   0   0  34     -2.460     -6.099     -1.200CRD F8D1
                                                                CRD F8D2
16   0   1   1   0   0   0   0   0     13.000       -8.0    -10.300CRD F8D1
                                          2.4       22.0       -0.3CRD F8D2
31   0   0   0   0         0.0                                 CARD F8C
16   0   1   1   0   0   0   0   0     13.000       -8.0    -10.300CRD F8D1
                                          0.7       17.5      -21.3CRD F8D2
 1   1   0   1   0   0   0   0  32     -2.445     -6.101     -1.213CRD F8D1
                                                                CRD F8D2
 1   1   0   1   0   0   0   0  32      -0.96       -6.0      -2.50CRD F8D1
                                                                CRD F8D2
 1  23   0   1   0   0   0   0   0       0.00       -5.7       3.80CRD F8D1
                                                                CRD F8D2
 1   1   0   1   0   0   0   0  32       0.01       -4.0      -4.50CRD F8D1
                                                                CRD F8D2
 2   2   0   1   0   0   0   0  32      1.818     -5.439     -1.820CRD F8D1
                                                                CRD F8D2
 2   2   0   1   0   0   0   0  32       2.50       -2.5      -1.50CRD F8D1
                                                                CRD F8D2
 3   3   0   1   0   0   0   0  32       3.00       -1.5       6.50CRD F8D1
                                                                CRD F8D2
 3   3   0   1   0   0   0   0  32      4.487     -0.133      3.734CRD F8D1
                                                                CRD F8D2
 3   3   0   1   0   0   0   0  32      4.421      3.319     -1.662CRD F8D1
                                                                CRD F8D2
 3   3   0   1   0   0   0   0  32      0.879      4.202     -5.672CRD F8D1
                                                                CRD F8D2
 3  22   0   0   0   0   0   0  32       0.30        0.2      -2.80CRD F8D1
                                                                CRD F8D2
 3   3   0   1   0   0   0   0  32      -1.00        4.3      -6.00CRD F8D1
                                                                CRD F8D2
 3   3   0   1   0   0   0   0  32      -2.50        4.3      -4.00CRD F8D1
                                                                CRD F8D2
16   0   1   1   0   0   0   0   0      0.000       5.00    -35.200CRD F8D1
                                          0.7       17.5      -21.3CRD F8D2
     0.0       0.0        0.0   0   0   0   0   0                 CARD G1A
 14.3810       0.0   -13.7500       0.0       0.0       0.0       CARD G2
     0.0     12.90        0.0       0.0       0.0       0.0  3  2  1  0CARD G3A
     0.0     12.95        0.0       0.0       0.0       0.0  3  2  1  0CARD G3A
     0.0     13.28        0.0       0.0       0.0       0.0  3  2  1  0CARD G3A
     0.0     13.46        0.0       0.0       0.0       0.0  3  2  1  0CARD G3A
     0.0     13.46        0.0       0.0       0.0       0.0  3  2  1  0CARD G3A
     0.0    92.900        0.0       0.0       0.0       0.0  3  2  1  0CARD G3A
     0.0    48.650        0.0       0.0       0.0       0.0  3  2  1  0CARD G3A
     0.0    128.80        0.0       0.0       0.0       0.0  3  2  1  0CARD G3A
     0.0    92.900        0.0       0.0       0.0       0.0  3  2  1  0CARD G3A
     0.0    48.650        0.0       0.0       0.0       0.0  3  2  1  0CARD G3A
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        0.0     128.80        0.0        0.0        0.0        0.0  3  2  1  OCARD G3A
        0.0      24.50        0.0        0.0        0.0        0.0  3  2  1  OCARD G3A
        0.0      85.00        0.0        0.0        0.0        0.0  3  2  1  OCARD G3A
        0.0      24.50        0.0        0.0        0.0        0.0  3  2  1  OCARD G3A
        0.0      85.00        0.0        0.0        0.0        0.0  3  2  1  OCARD G3A
    3     3          0.0        0.0        0.0                                CARD H1A
       1 -5          0.0        0.0        0.0                                CARD H1B
      16  5          0.0        0.0        0.0                                CARD H1B
    3     3          0.0        0.0        0.0                                CARD H2A
          5          0.0        0.0        0.0                                CARD H2B
       3  5          0.0        0.0        0.0                                CARD H2B
    3     3          0.0        0.0        0.0                                CARD H3A
          5          0.0        0.0        0.0                                CARD H3B
       3  5          0.0        0.0        0.0                                CARD H3B
    3     3     5 16  5                                                       CARD H4
    3     3     5  5  5                                                       CARD H5
    3     3     5  3  5                                                       CARD H6
    2     3     4                                                             CARD H7
    0                                                                         CARD H8
    1  5  4                                                                   CARD H9
    1                                                                         CRD H10A
16 15  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15                            CRD H10B
  2    1                                                                      CARD H11
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DEVELOPED BY CALSPAN CORP., P.O. BOX 400, BUFFALO NY 14225
AND BY J&J TECHNOLOGIES INC., ORCHARD PARK, NY 14127

FOR THE AIR FORCE ARMSTRONG AEROSPACE MEDICAL RESEARCH
LABORATORY, WRIGHT PATTERSON AIR FORCE BASE
UNDER CONTRACTS F33615-75C-5002,-78C-0516 AND -80C-05117

AND FOR THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION,
U.S. DEPARTMENT OF TRANSPORTATION, UNDER CONTRACTS
FH-11-7592, HS-053-2-485, HS-6-01300 AND HS-6-01410.

PROGRAM DOCUMENTATION: NHTSA REPORT NOS. DOT-HS-801-507
THROUGH 510 (FORMERLY CALSPAN REPORT NO. ZQ-5180-L-1),
AVAILABLE FROM NTIS (ACCESSION NOS. PB-241692,3,4 AND 5),
APPENDIXES A-J TO THE ABOVE (AVAILABLE FROM CALSPAN),
AND REPORT NOS. AMRL-TR-75-14 (NTIS NO. AD-A014 816),
AFAMRL-TR-80-14 (NTIS NO. AD-A088 029), AND
AFAMRL-TR-83-073 (NTIS NO. AD-B079 184).

PROGRAM ATB-IV, EXECUTED ON THE AAMRL/BB CONCURRENT
3250 COMPUTER, WRIGHT-PATTERSON AFB, OHIO

2 SEPT 1988 IRSIN= 0 IRSOUT= 0 RSTIME = 0.0000 CARDS A

EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

UNITL = IN. UNITM = LB. UNITT = SEC. GRAVITY VECTOR = (0.0000, 0.0000, 386.0880) G = 386.0880

NDINT = 4 NSTEPS = 40 DT =0.002000 H0 =0.000500 HMAX =0.001000 HMIN =0.000063

NPRT ARRAY

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	0	40	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

CRASH VICTIM 95TH PERCENTILE MALE 15 SEGMENTS 14 JOINTS

CARD B.1
CARDS B.2

SEGMENT			WEIGHT	PRINCIPAL MOMENTS OF INERTIA (LB.-SEC.**2- IN.)			SEGMENT CONTACT ELLIPSOID SEMIAXES (IN.)			CENTER (IN.)			PRINCIPAL AXES (DEG)		
I	SYM	PLOT	(LB.)	X	Y	Z	X	Y	Z	X	Y	Z	YAW	PITCH	ROLL
1	LT	1	34.772	1.6280	1.0101	1.7954	5.168	7.436	3.778	0.000	0.000	-0.072	0.00	0.00	0.00
2	CT	2	13.099	0.4160	0.2301	0.5857	4.809	8.673	4.145	0.000	0.000	-0.011	0.00	0.00	0.00
3	UT	3	53.673	3.4525	2.7832	2.3509	5.220	8.906	7.314	0.000	0.000	-0.872	0.00	0.00	0.00
4	N	4	3.289	0.0278	0.0278	0.0218	2.520	2.520	3.156	0.000	0.000	0.000	0.00	0.00	0.00
5	H	5	11.927	0.2708	0.3085	0.1584	3.984	3.125	5.836	0.000	0.000	0.000	0.00	0.00	0.00
6	RUL	6	22.725	2.0130	2.0130	0.2576	3.308	3.308	12.652	0.000	0.000	0.000	0.00	0.00	0.00
7	RLL	7	9.763	0.4989	0.4989	0.0626	2.487	2.487	9.616	0.000	0.000	0.000	0.00	0.00	0.00
8	RF	8	2.079	0.0426	0.0412	0.0055	2.866	2.016	5.617	0.000	0.000	1.462	0.00	0.00	0.00
9	LUL	9	22.725	2.0130	2.0130	0.2576	3.308	3.308	12.652	0.000	0.000	0.000	0.00	0.00	0.00
10	LLL	A	9.763	0.4989	0.4989	0.0626	2.487	2.487	9.616	0.000	0.000	0.000	0.00	0.00	0.00
11	LF	B	2.079	0.0426	0.0412	0.0055	2.866	2.016	5.617	0.000	0.000	1.462	0.00	0.00	0.00
12	RUA	C	5.542	0.1743	0.1743	0.0259	2.122	2.122	7.497	0.000	0.000	0.000	0.00	0.00	0.00
13	RLA	D	5.901	0.3331	0.3331	0.0214	1.871	1.871	10.269	0.000	0.000	0.000	0.00	0.00	0.00
14	LUA	E	5.542	0.1743	0.1743	0.0259	2.122	2.122	7.497	0.000	0.000	0.000	0.00	0.00	0 00
15	LLA	F	5.901	0.3331	0.3331	0.0214	1.871	1.871	10.269	0.000	0.000	0.000	0.00	0.00	0.00

CARDS B.3

JOINT					LOCATION(IN.) - SEG(JNT)			LOCATION(IN.) - SEG(J+1)			PRIN. AXIS(DEG) - SEG(JNT)			PRIN. AXIS(DEG) - SEG(J+1)		
J	SYM	PLOT	JNT	PIN	X	Y	Z	X	Y	Z	YAW	PITCH	ROLL	YAW	PITCH	ROLL
1	P	M	1	0	0.000	0.000	-3.850	0.000	0.000	1.610	0.00	0.00	0.00	0.00	5.00	0.00
2	W	N	2	0	0.000	0.000	-1.640	0.000	0.000	6.440	0.00	0.00	0.00	0.00	5.00	0.00
3	NP	O	3	0	0.000	0.000	-8.190	0.000	0.000	0.640	0.00	0.00	0.00	0.00	10.00	0.00
4	HP	P	4	0	0.000	0.000	-0.640	0.000	0.000	5.840	0.00	0.00	0.00	0.00	10.00	0.00
5	RH	Q	1	0	0.000	3.420	-0.310	0.000	0.000	-8.640	0.00	0.00	0.00	0.00	-45.00	0.00
6	RK	R	6	1	0.000	0.000	10.000	0.000	0.000	-6.970	0.00	0.00	0.00	0.00	60.00	0.00
7	RA	S	7	0	0.000	0.000	8.120	2.870	0.000	-2.660	0.00	90.00	0.00	0.00	10.00	0.00
8	LH	T	1	0	0.000	-3.420	-0.310	0.000	0.000	-8.640	0.00	0.00	0.00	0.00	-45.00	0.00
9	LK	U	9	1	0.000	0.000	10.000	0.000	0.000	-6.970	0.00	0.00	0.00	0.00	60.00	0.00
10	LA	V	10	0	0.000	0.000	8.120	2.870	0.000	-2.660	0.00	90.00	0.00	0.00	10.00	0.00
11	RS	W	3	0	0.000	6.240	-5.220	0.000	0.000	-5.370	0.00	0.00	0.00	0.00	-4.10	0.00
12	RE	X	12	1	0.000	0.000	5.420	0.000	0.000	-8.200	0.00	0.00	0.00	0.00	-70.00	0.00
13	LS	Y	3	0	0.000	-6.240	-5.220	0.000	0.000	-5.370	0.00	0.00	0.00	0.00	-4.10	0.00
14	LE	Z	14	1	0.000	0.000	5.420	0.000	0.000	-8.200	0.00	0.00	0.00	0.00	-70.00	0.00

CARDS B.4

JOINT		FLEXURAL SPRING CHARACTERISTICS: SPRING COEF. (IN. LB./DEG**J) LINEAR (J=1)	QUADRATIC (J=2)	CUBIC (J=3)	ENERGY DISSIPATION COEF.	JOINT STOP (DEG)	TORSIONAL SPRING CHARACTERISTICS: SPRING COEF. (IN. LB./DEG**J) LINEAR (J=1)	QUADRATIC (J=2)	CUBIC (J=3)	ENERGY DISSIPATION COEF.	JOINT STOP (DEG)
1	P	0.000	10.000	0.000	0.700	20.000	0.000	10.000	0.000	0.700	5.000
2	W	0.000	10.000	0.000	0.700	20.000	0.000	10.000	0.000	0.700	35.000
3	NP	0.000	5.000	0.000	0.700	25.000	0.000	10.000	0.000	0.700	35.000
4	HP	0.000	5.000	0.000	0.700	25.000	0.000	10.000	0.000	0.700	35.000
5	RH	0.000	10.000	0.000	0.700	70.000	0.000	0.800	0.000	0.700	40.000
6	RK	0.000	1.800	0.000	0.700	60.000	0.000	0.000	0.000	0.000	0.000
7	RA	0.000	7.000	0.000	0.700	35.000	0.000	10.000	0.000	0.700	28.000
8	LH	0.000	10.000	0.000	0.700	70.000	0.000	0.800	0.000	0.700	40.000
9	LK	0.000	1.800	0.000	0.700	60.000	0.000	0.000	0.000	0.000	0.000
10	LA	0.000	7.000	0.000	0.700	35.000	0.000	10.000	0.000	0.700	28.000
11	RS	0.000	10.000	0.000	0.700	122.500	0.000	10.000	0.000	0.700	65.000
12	RE	0.000	1.800	0.000	0.700	70.000	0.000	0.000	0.000	0.000	0.000
13	LS	0.000	10.000	0.000	0.700	122.500	0.000	10.000	0.000	0.700	65.000
14	LE	0.000	1.800	0.000	0.700	70.000	0.000	0.000	0.000	0.000	0.000

CARDS B.5

JOINT VISCOUS CHARACTERISTICS AND LOCK-UNLOCK CONDITIONS

JOINT		VISCOUS COEFFICIENT (IN. LB.SEC./DEG)	COULOMB FRICTION COEF. (IN. LB.)	FULL FRICTION ANGULAR VELOCITY (DEG/SEC.)	MAX TORQUE FOR A LOCKED JOINT (IN. LB.)	MIN TORQUE FOR UNLOCKED JOINT (IN. LB.)	MIN. ANG. VELOCITY FOR UNLOCKED JOINT (RAD/SEC.)	IMPULSE RESTITUTION COEFFICIENT
1	P	0.100	0.00	30.00	0.00	0.00	0.00	0.000
2	W	0.100	0.00	30.00	0.00	0.00	0.00	0.000
3	NP	0.100	0.00	30.00	0.00	0.00	0.00	0.000
4	HP	0.100	0.00	30.00	0.00	0.00	0.00	0.000
5	RH	0.100	0.00	30.00	0.00	0.00	0.00	0.000
6	RK	0.100	0.00	30.00	0.00	0.00	0.00	0.000
7	RA	0.100	0.00	30.00	0.00	0.00	0.00	0.000
8	LH	0.100	0.00	30.00	0.00	0.00	0.00	0.000
9	LK	0.100	0.00	30.00	0.00	0.00	0.00	0.000
10	LA	0.100	0.00	30.00	0.00	0.00	0.00	0.000
11	RS	0.100	0.00	30.00	0.00	0.00	0.00	0.000
12	RE	0.100	0.00	30.00	0.00	0.00	0.00	0.000
13	LS	0.100	0.00	30.00	0.00	0.00	0.00	0.000
14	LE	0.100	0.00	30.00	0.00	0.00	0.00	0.000

SEGMENT INTEGRATION CONVERGENCE TEST INPUT

SEGMENT		ANGULAR VELOCITIES (RAD/SEC.)			LINEAR VELOCITIES (IN./SEC.)			ANGULAR ACCELERATIONS (RAD/SEC.**2)			LINEAR ACCELERATIONS (IN./SEC.**2)		
NO.	SYM	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR	MAG. TEST	ABS. ERROR	REL. ERROR
1	LT	0.010	0.010	0.0100	0.010	0.010	0.0100	0.100	0.100	0.1000	0.100	0.100	0.0100
2	CT	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
3	UT	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
4	N	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
5	H	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
6	RUL	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
7	RLL	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
8	RF	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
9	LUL	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
10	LLL	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
11	LF	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
12	RUA	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
13	RLA	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
14	LUA	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000
15	LLA	0.010	0.010	0.0100	0.000	0.000	0.0000	0.100	0.100	0.1000	0.000	0.000	0.0000

VEHICLE DECELERATION INPUTS

SLED ACCELERATION - 20G PEAK

YAW	PITCH	ROLL	VIPS	VTIME	XO(X)	XO(Y)	XO(Z)	NATAB	ATO	ADT	NSFG
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	15	0.000000	0.010000	0

UNIDIRECTIONAL VEHICLE POSITION TABLES

TIME (MSEC)	ACC (G)	VELOCITY (IN./SEC.)	POSITION (IN.)	TIME (MSEC)	ACC (G)	VELOCITY (IN./SEC.)	POSITION (IN.)
0.00000	0.00	0.0000	0.00000				
10.00000	5.00	-9.6522	-0.03217				
20.00000	10.00	-38.6088	-0.25739				
30.00000	15.00	-86.8698	-0.86870				
40.00000	20.00	-154.4352	-2.05914				
50.00000	15.00	-222.0006	-3.95740				
60.00000	10.00	-270.2616	-6.43480				
70.00000	5.00	-299.2182	-9.29820				
80.00000	0.00	-308.8704	-12.35482				
90.00000	0.00	-308.8704	-15.44352				
100.00000	0.00	-308.8704	-18.53222				
110.00000	0.00	-308.8704	-21.62093				
120.00000	0.00	-308.8704	-24.70963				
130.00000	0.00	-308.8704	-27.79834				
140.00000	0.00	-308.8704	-30.88704				

CARD D.1

NPL	NBLT	NBAG	NELP	NQ	NSD	NHRNSS	NWINDF	NJNTF	NFORCE
12	0	0	3	0	0	1	0	0	0

CARDS D.2

PLANE INPUTS

PLANE NO. 1 SEAT. 6 DEGREE OFF H

	X	Y	Z
POINT 1	10.0000	8.0000	-10.0000
POINT 2	28.0100	8.0000	-11.8900
POINT 3	10.0000	-8.0000	-10.0000

PLANE NO. 2 BACK PANEL. 13 DEGR

	X	Y	Z
POINT 1	1.0000	9.0000	-48.9700
POINT 2	10.0000	9.0000	-10.0000
POINT 3	1.0000	-9.0000	-48.9700

PLANE NO. 3 FLOOR.

	X	Y	Z
POINT 1	0.0000	12.0000	-1.3000
POINT 2	60.0000	12.0000	-1.3000
POINT 3	0.0000	-12.0000	-1.3000

PLANE NO. 4 HEAD PAD. 13 DEGR

	X	Y	Z
POINT 1	2.4800	7.5000	-47.2600
POINT 2	4.9600	7.5000	-36.5500
POINT 3	2.4800	-7.5000	-47.2600

PLANE NO. 5 SEAT FRONT PANEL.

	X	Y	Z
POINT 1	28.0100	8.0000	-11.8900
POINT 2	26.6600	8.0000	-4.4000
POINT 3	28.0100	-8.0000	-11.8900

PLANE NO. 6 BACK PANEL2. 13 DEGR

	X	Y	Z
POINT 1	1.0000	9.0000	-48.9700
POINT 2	10.0000	9.0000	-10.0000
POINT 3	1.0000	-9.0000	-48.9700

PLANE NO. 7 FIREWALL.

	X	Y	Z
POINT 1	60.0000	12.0000	-25.0000
POINT 2	60.0000	-12.0000	-25.0000
POINT 3	60.0000	12.0000	-0.7500

PLANE NO. 8 RIGHT SIDE SEAT/IN.

	X	Y	Z
POINT 1	8.4100	8.1000	-6.6600
POINT 2	8.7000	8.1000	-14.7300
POINT 3	30.5800	8.1000	-6.8400

PLANE NO. 9 LEFT SIDE SEAT/IN.

	X	Y	Z
POINT 1	8.4100	-8.1000	-6.6600
POINT 2	30.5800	-8.1000	-6.8400
POINT 3	8.7000	-8.1000	-14.7300

PLANE NO. 10 RUDDER PEDALS.

	X	Y	Z
POINT 1	49.9920	9.0000	-2.2392
POINT 2	52.9920	9.0000	-4.7565
POINT 3	49.9920	-9.0000	-2.2392

PLANE NO. 11 LEFT SIDE PANEL.

	X	Y	Z
POINT 1	1.0000	-9.0000	-48.9700
POINT 2	10.9000	-9.0000	-6.1000
POINT 3	-7.7700	-9.0000	-46.9500

PLANE NO. 12 RIGHT SIDE PANEL.

	X	Y	Z
POINT 1	1.0000	9.0000	-48.9700
POINT 2	-7.7700	9.0000	-46.9500
POINT 3	10.9000	9.0000	-6.1000

ADDITIONAL ELLIPSOID INPUT

CARDS D.5

NO.	SEMIAXES (IN.) X	Y	Z	OFFSET (IN.) X	Y	Z	ROTATION (DEG) YAW	PITCH	ROLL	POWER		
22	4.500	3.000	3.000	0.000	4.000	-3.500	0.000	0.000	0.000	0.	0.	0.
23	3.200	8.000	8.000	0.000	0.000	-7.000	0.000	0.000	0.000	0.	0.	0.
24	6.000	15.000	5.000	38.000	0.000	-28.000	0.000	0.000	0.000	20.	20.	20.

BODY SEGMENT SYMMETRY INPUT

CARD D 7

SEG NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NSYM(J)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CARDS E

FUNCTION NO. 3 SEGMENT-SEGMENT FCN. NTI(3) = 1

D0	D1	D2	D3	D4
0.0000	-5.0000	0.0000	0.0000	1.0000

FIRST PART OF FUNCTION - 6 TABULAR POINTS

D	F(D)
0.000000	0.0000
1.000000	470.0000
2.000000	890.0000
3.000000	1220.0000
4.000000	1470.0000
5.000000	1580.0000

CARDS E

FUNCTION NO. 6 CONSTANT, F=0.0 NTI(6) = 19

D0	D1	D2	D3	D4
0.0000	0.0000	0.0000	0.0000	0.0000

FUNCTION IS CONSTANT 0.000000

CARDS E

FUNCTION NO. 7 R FACTOR. NTI(7) = 24

D0	D1	D2	D3	D4
0.0000	0.0000	0.7000	0.0000	0.0000

FUNCTION IS CONSTANT 0 700000

CARDS E

FUNCTION NO. 13 STIFF SURFACES NTI(13) = 29

D0	D1	D2	D3	D4
0.0000	-4.0000	0.0000	0.0000	1.0000

FIRST PART OF FUNCTION - 8 TABULAR POINTS

D	F(D)
0.000000	0.0000
0.100000	5.0000
0.200000	20.0000
0.300000	40.0000
0.400000	60.0000
1.000000	860.0000
2.000000	2400.0000
3.000000	4000.0000

FUNCTION NO. 14 FRICTION FUNC. NTI(14) = 51 CARDS E

D0	D1	D2	D3	D4
0.0000	0.0000	0.5000	0.0000	1.0000

FUNCTION IS CONSTANT 0.500000

FUNCTION NO. 19 CF=.25,CREST=.25 NTI(19) = 56 CARDS E

D0	D1	D2	D3	D4
0.0000	0.0000	0.2500	0.0000	0.0000

FUNCTION IS CONSTANT 0.250000

FUNCTION NO. 20 DAMPING COEFF. C=900 NTI(20) = 61

D0	D1	D2	D3	D4
0.0000	1.0000	0.0000	0.0000	1.0000

FIRST PART OF FUNCTION - 5TH DEGREE POLYNOMIAL

A0	A1	A2	A3	A4	A5
0.000000	900.000000	0.000000	0.000000	0.000000	0.000000

FUNCTION NO. 21 RATE OF DEFLEC. NTI(21) = 72

D0	D1	D2	D3	D4
-40.0000	-150.0000	0.0000	0.0000	1.0000

FIRST PART OF FUNCTION - 21 TABULAR POINTS

D	F(D)
-40.000000	0.0000
-30.000000	0.0000
-20.000000	0.0000
-10.000000	0.0000
0.000000	0.0000
5.000000	1.0000
10.000000	1.0000
20.000000	0.9900
30.000000	0.9650
40.000000	0.9280
50.000000	0.8600
60.000000	0.6900
70.000000	0.4750
80.000000	0.3400
90.000000	0.2600
100.000000	0.2000
110.000000	0.1800
120.000000	0.0900
130.000000	0.0600
140.000000	0.0250
150.000000	0.0000

FUNCTION NO. 22 DAMPING COEFF. C=35 NTI(22) = 120 CARDS E

D0	D1	D2	D3	D4
0.0000	1.0000	0.0000	0.0000	1.0000

FIRST PART OF FUNCTION - 5TH DEGREE POLYNOMIAL

A0	A1	A2	A3	A4	A5
0.000000	35.000000	0.000000	0.000000	0.000000	0.000000

FUNCTION NO. 24 DAMPING COEFF. C=0.8 NTI(24) = 131 CARDS E

D0	D1	D2	D3	D4
-1000.0000	-1000.0000	0.0000	0.0000	1.0000

FIRST PART OF FUNCTION - 4 TABULAR POINTS

D	F(D)
-1000.000000	0.6000
-1.000000	0.6000
0.000000	1.0000
1000.000000	1.0000

FUNCTION NO. 25 DAMPING COEFF C=1100 NTI(25) = 145

D0	D1	D2	D3	D4
0.0000	1.0000	0.0000	0.0000	1.0000

FIRST PART OF FUNCTION - 5TH DEGREE POLYNOMIAL

A0	A1	A2	A3	A4	A5
0.000000	1100.000000	0.000000	0.000000	0.000000	0.000000

FUNCTION NO. 26 STIFF SURFACES-LL NTI(26) = 156 CARDS E

D0	D1	D2	D3	D4
0.0000	-4.0000	0.0000	0.0000	1.0000

FIRST PART OF FUNCTION - 8 TABULAR POINTS

D	F(D)
0.000000	0.0000
0.100000	5.0000
0.200000	20.0000
0.300000	40.0000
0.400000	60.0000
2.000000	860.0000
3.000000	2400.0000
4.000000	4000.0000

FUNCTION NO. 31 HARNESS FDF NTI(31) = 170 CARDS E

D0	D1	D2	D3	D4
0.0000	-4.0000	0.0000	0.0000	0.0000

FIRST PART OF FUNCTION - 8 TABULAR POINTS

D	F(D)
0.000000	0.0000
0.010000	150.0000
0.020000	300.0000
0.030000	450.0000
0.050000	850.0000
0.100000	3500.0000
1.000000	35000.0000
4.000000	140000.0000

FUNCTION NO. 32 HARNESS FRICTION NTI(32) = 200 CARDS E

D0	D1	D2	D3	D4
0.0000	0.0000	0.2000	0.0000	0.2000

FUNCTION IS CONSTANT 0.200000

FUNCTION NO. 34 HARNESS FRICTION NTI(34) = 205

D0	D1	D2	D3	D4
0.0000	0.0000	0.9000	0.0000	0.2000

FUNCTION IS CONSTANT 0.900000

PLANE	SEGMENT	FORCE DEFLECTION	INERTIAL SPIKE	R FACTOR	G FACTOR	FRICTION COEF.	OPT
1- 16	1- 1	13	-20	-21	0	14	1
SEAT. 6 DEGREE OFF H	LT	STIFF SURFACES	DAMPING COEFF. C=900	RATE OF DEFLEC.		FRICTION FUNC.	
1- 16	6- 6	13	-25	-21	0	14	1
SEAT. 6 DEGREE OFF H	RUL	STIFF SURFACES	DAMPING COEFF C=1100	RATE OF DEFLEC.		FRICTION FUNC.	
1- 16	9- 9	13	-25	-21	0	14	1
SEAT. 6 DEGREE OFF H	LUL	STIFF SURFACES	DAMPING COEFF C=1100	RATE OF DEFLEC.		FRICTION FUNC.	
2- 16	1- 1	13	-20	-21	0	14	1
BACK PANEL. 13 DEGR	LT	STIFF SURFACES	DAMPING COEFF. C=900	RATE OF DEFLEC.		FRICTION FUNC.	
2- 16	2- 2	13	-20	-21	0	14	1
BACK PANEL. 13 DEGR	CT	STIFF SURFACES	DAMPING COEFF. C=900	RATE OF DEFLEC.		FRICTION FUNC.	
2- 16	3- 3	13	-20	-21	0	14	1
BACK PANEL. 13 DEGR	UT	STIFF SURFACES	DAMPING COEFF. C=900	RATE OF DEFLEC.		FRICTION FUNC.	
3- 16	8- 8	13	-22	-21	0	14	-1
FLOOR.	RF	STIFF SURFACES	DAMPING COEFF. C=35	RATE OF DEFLEC.		FRICTION FUNC.	
3- 16	11- 11	13	-22	-21	0	14	-1
FLOOR.	LF	STIFF SURFACES	DAMPING COEFF. C=35	RATE OF DEFLEC.		FRICTION FUNC.	
4- 16	5- 5	13	-22	-21	0	14	1
HEAD PAD. 13 DEGR	H	STIFF SURFACES	DAMPING COEFF. C=35	RATE OF DEFLEC.		FRICTION FUNC.	
10- 16	8- 8	13	-22	-21	0	14	1
RUDDER PEDALS.	RF	STIFF SURFACES	DAMPING COEFF. C=35	RATE OF DEFLEC.		FRICTION FUNC.	
10- 16	11- 11	13	-22	-21	0	14	1
RUDDER PEDALS.	LF	STIFF SURFACES	DAMPING COEFF. C=35	RATE OF DEFLEC.		FRICTION FUNC.	

CARDS F.3

SEGMENT	SEGMENT	FORCE DEFLECTION	INERTIAL SPIKE	R FACTOR	G FACTOR	FRICTION COEF.	OPT
2- 2	13- 13	3	0	7	0	19	0
CT	RLA SEGMENT-SEGMENT FCN.			R FACTOR.		CF=.25,CREST=.25	
2- 2	15- 15	3	0	7	0	19	0
CT	LLA SEGMENT-SEGMENT FCN.			R FACTOR.		CF=.25,CREST=.25	
6- 6	13- 13	3	0	7	0	19	0
RUL	RLA SEGMENT-SEGMENT FCN.			R FACTOR.		CF=.25,CREST=.25	
9- 9	15- 15	3	0	7	0	19	0
LUL	LLA SEGMENT-SEGMENT FCN.			R FACTOR.		CF=.25,CREST=.25	
13- 13	16- 24	13	-22	-21	0	14	0
RLA	VEH STIFF SURFACES		DAMPING COEFF. C=35	RATE OF DEFLEC.		FRICTION FUNC.	
15- 15	16- 24	13	-22	-21	0	14	0
LLA	VEH STIFF SURFACES		DAMPING COEFF. C=35	RATE OF DEFLEC.		FRICTION FUNC.	

HARNESS-BELT SYSTEM INPUT

NO. OF HARNESSES = 1

NO. OF BELTS PER HARNESS = 2

FOR HARNESS NO. 1 NO. OF POINTS PER BELT = 12 15

HARNESS NO. 1 BELT NO. 1 FUNCTION NOS. 31 0 0 0 0 REFERENCE SLACK = 0.000 IN.

CARDS F.8.D

N	NS	NE	NT	NPD	NDR	FUNCTION NOS.				
1	16	0	109	1	1	0	0	0	0	0
2	1	1	115	0	1	0	0	0	0	34
3	1	1	121	0	1	0	0	0	0	34
4	1	1	127	0	1	0	0	0	0	34
5	1	1	133	0	1	0	0	0	0	34
6	1	23	139	0	1	0	0	0	0	0
7	1	1	145	0	1	0	0	0	0	34
8	1	1	151	0	1	0	0	0	0	34
9	1	1	157	0	1	0	0	0	0	34
10	1	1	163	0	1	0	0	0	0	34
11	1	1	169	0	1	0	0	0	0	34
12	16	0	175	1	1	0	0	0	0	0

	BASE REFERENCE (IN.)			ADJUSTED REFERENCE (IN.)			OFFSET (IN.)			PREFERRED DIRECTION (IN.)		
N	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
1	13.000	8.000	-10.300	13.000	8.000	-10.300	0.000	0.000	0.000	2.400	22.000	-0.300
2	-1.178	7.075	-0.781	-1.178	7.075	-0.781	0.000	0.000	-0.072	0.000	0.000	0.000
3	-0.029	6.796	-1.534	-0.029	6.795	-1.534	0.000	0.000	-0.072	0.000	0.000	0.000
4	0.910	5.778	-2.283	0.910	5.778	-2.283	0.000	0.000	-0.072	0.000	0.000	0.000
5	2.228	2.355	-3.192	2.228	2.355	-3.192	0.000	0.000	-0.072	0.000	0.000	0.000
6	2.957	0.000	3.059	2.957	0.000	3.059	0.000	0.000	-7.000	0.000	0.000	0.000
7	3.070	-0.080	-4.410	2.344	-0.061	-3.367	0.000	0.000	-0.072	0.000	0.000	0.000
8	1.785	-2.325	-3.343	1.785	-2.325	-3.343	0.000	0.000	-0.072	0.000	0.000	0.000
9	0.011	-5.145	-2.728	0.011	-5.145	-2.728	0.000	0.000	-0.072	0.000	0.000	0.000
10	-0.880	-5.789	-2.282	-0.880	-5.789	-2.282	0.000	0.000	-0.072	0.000	0.000	0.000
11	-2.460	-6.099	-1.200	-2.460	-6.098	-1.200	0.000	0.000	-0.072	0.000	0.000	0.000
12	13.000	-8.000	-10.300	13.000	-8.000	-10.300	0.000	0.000	0.000	2.400	22.000	-0.300

HARNESS NO. 1 BELT NO. 2 FUNCTION NOS. 31 0 0 0 0 REFERENCE SLACK = 0.000 IN.

CARDS F.8.D

N	NS	NE	NT	NPD	NDR	FUNCTION NOS.				
13	16	0	187	1	1	0	0	0	0	0
14	1	1	193	0	1	0	0	0	0	32
15	1	1	199	0	1	0	0	0	0	32
16	1	23	205	0	1	0	0	0	0	0
17	1	1	211	0	1	0	0	0	0	32
18	2	2	217	0	1	0	0	0	0	32
19	2	2	223	0	1	0	0	0	0	32
20	3	3	229	0	1	0	0	0	0	32
21	3	3	235	0	1	0	0	0	0	32
22	3	3	241	0	1	0	0	0	0	32
23	3	3	247	0	1	0	0	0	0	32
24	3	22	253	0	0	0	0	0	0	32
25	3	3	259	0	1	0	0	0	0	32
26	3	3	265	0	1	0	0	0	0	32
27	16	0	271	1	1	0	0	0	0	0

	BASE REFERENCE (IN.)			ADJUSTED REFERENCE (IN.)			OFFSET (IN.)			PREFERRED DIRECTION (IN.)		
N	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
13	13.000	-8.000	-10.300	13.000	-8.000	-10.300	0.000	0.000	0.000	0.700	17.500	-21.300
14	-2.445	-6.101	-1.213	-2.445	-6.101	-1.213	0.000	0.000	-0.072	0.000	0.000	0.000
15	-0.960	-6.000	-2.500	-0.906	-5.661	-2.359	0.000	0.000	-0.072	0.000	0.000	0.000
16	0.000	-5.700	3.800	0.000	-5.367	3.578	0.000	0.000	-7.000	0.000	0.000	0.000
17	0.010	-4.000	-4.500	0.008	-3.061	-3.443	0.000	0.000	-0.072	0.000	0.000	0.000
18	1.818	-5.439	-1.820	1.818	-5.439	-1.820	0.000	0.000	-0.011	0.000	0.000	0.000
19	2.500	-2.500	-1.500	3.397	-3.397	-2.038	0.000	0.000	-0.011	0.000	0.000	0.000
20	3.000	-1.500	6.500	2.777	-1.388	6.016	0.000	0.000	-0.872	0.000	0.000	0.000
21	4.487	-0.133	3.734	4.487	-0.133	3.734	0.000	0.000	-0.872	0.000	0.000	0.000
22	4.421	3.319	-1.662	4.421	3.319	-1.662	0.000	0.000	-0.872	0.000	0.000	0.000
23	0.879	4.202	-5.672	0.879	4.202	-5.672	0.000	0.000	-0.872	0.000	0.000	0.000
24	0.300	0.200	-2.800	0.320	0.213	-2.985	0.000	4.000	-3.500	0.000	0.000	0.000
25	-1.000	4.300	-6.000	-0.955	4.105	-5.728	0.000	0.000	-0.872	0.000	0.000	0.000
26	-2.500	4.300	-4.000	-2.612	4.492	-4.179	0.000	0.000	-0.872	0.000	0.000	0.000
27	0.000	5.000	-35.200	0.000	5.000	-35.200	0.000	0.000	0.000	0.700	17.500	-21.300

ZPLT(X)	ZPLT(Y)	ZPLT(Z)	I1	J1	I2	J2	I3	SPLT(1)	SPLT(2)	SPLT(3)
0.	0.	0.	0	0	0	0	0	10.00	6.00	1.00

INITIAL POSITIONS (INERTIAL REFERENCE) CARDS G.2

SEGMENT		LINEAR POSITION (IN.)			LINEAR VELOCITY (IN./SEC.)		
NO.	SEG	X	Y	Z	X	Y	Z
1	LT	14.38100	0.00000	-13.75000	0.00000	0.00000	0.00000
2	CT	13.16068	0.00000	-19.07188	0.00000	0.00000	0.00000
3	UT	11.31383	0.00000	-26.93796	0.00000	0.00000	0.00000
4	N	9.28353	0.00000	-35.53137	0.00000	0.00000	0.00000
5	H	7.77521	0.00000	-41.83338	0.00000	0.00000	0.00000
6	RUL	22.94073	3.42000	-14.48930	0.00000	0.00000	0.00000
7	RLL	38.16022	3.42000	-10.39045	0.00000	0.00000	0.00000
8	RF	48.12719	3.42000	-4.45598	0.00000	0.00000	0.00000
9	LUL	22.94073	-3.42000	-14.48930	0.00000	0.00000	0.00000
10	LLL	38.16022	-3.42000	-10.39045	0.00000	0.00000	0.00000
11	LF	48.12719	-3.42000	-4.45598	0.00000	0.00000	0.00000
12	RUA	12.34164	6.24000	-27.13188	0.00000	0.00000	0.00000
13	RLA	22.75808	6.24000	-21.48521	0.00000	0.00000	0.00000
14	LUA	12.34164	-6.24000	-27.13188	0.00000	0.00000	0.00000
15	LLA	22.75808	-6.24000	-21.48521	0.00000	0.00000	0.00000

INITIAL ANGULAR ROTATION AND VELOCITY CARDS G.3

SEGMENT		ANGULAR ROTATION (DEG)			ANGULAR VELOCITY (DEG/SEC.)			IYPR			
NO.	SEG	YAW	PITCH	ROLL	X	Y	Z				
1	LT	0.00000	12.90000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
2	CT	0.00000	12.95000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
3	UT	0.00000	13.28000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
4	N	0.00000	13.46000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
5	H	0.00000	13.46000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
6	RUL	0.00000	92.90000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
7	RLL	0.00000	48.65000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
8	RF	0.00000	128.80000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
9	LUL	0.00000	92.90000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
10	LLL	0.00000	48.65000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
11	LF	0.00000	128.80000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
12	RUA	0.00000	24.50000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
13	RLA	0.00000	85.00000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
14	LUA	0.00000	24.50000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
15	LLA	0.00000	85.00000	0.00000	0.00000	0.00000	0.00000	3	2	1	0

LINEAR AND ANGULAR VELOCITIES HAVE BEEN SET EQUAL TO THE INITIAL VEHICLE VELOCITIES.

```
HBPLAY TIME =     0.000 MSEC. NH,NB,NPTS NT=    1    1   11   103
NL(I)=      1     2     3     4     5     6     8     9    10    11    12
BB   =        4.124  1.402  1.574  3.779  -2.557  2.656  3.388  1.187  1.940  4.738

HBPLAY TIME =     0.000 MSEC. NH,NB,NPTS NT=    1    2    7   181
NL(I)=     13    14    18    21    22    23    27
BB   =        4.748  7.394  6.842  6.406  5.423  10.829
```

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TABULAR TIME HISTORY CONTROL PARAMETERS
TYPE  NSG     SELECTED SEGMENTS OR JOINTS
 H.1   3     3 -5  5
   REF       0  1 16
 H.2   3     3  5  5
   REF       0  0  3
 H.3   3     3  5  5
   REF       0  0  3
 H.4   3     3  5  5
   REF       0  0 16
 H.5   3     3  5  5
   REF       0  0  5
 H.6   3     3  5  5
   REF       0  0  3
 H.7   2     3  4
   REF       0  0
 H.8   0
   REF
 H.9   1     4
   REF       5
 H.10 15     1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
   REF      16
```

SEGMENT	(INERTIAL) ANGULAR ROTATION (DEG) YAW	PITCH	ROLL	(LOCAL) ANGULAR VELOCITY (RAD/SEC.) X	Y	Z	(LOCAL) ANGULAR ACCELERATION (RAD/SEC.**2) X	Y	Z
1 LT	0.0000	12.9000	0.0000	0.00000	0.00000	0.00000	0.000000	-26.834649	0.000000
2 CT	0.0000	12.9500	0.0000	0.00000	0.00000	0.00000	0.000000	40.304245	0.000000
3 UT	0.0000	13.2800	0.0000	0.00000	0.00000	0.00000	0.000000	-0.859459	0.000000
4 N	0.0000	13.4600	0.0000	0.00000	0.00000	0.00000	0.000000	13.637948	0.000000
5 H	0.0000	13.4600	0.0000	0.00000	0.00000	0.00000	0.000000	-1.165343	0.000000
6 RUL	0.0000	92.9000	0.0000	0.00000	0.00000	0.00000	0.000000	-2.405246	0.000000
7 RLL	0.0000	48.6500	0.0000	0.00000	0.00000	0.00000	0.000000	-12.215669	0.000000
8 RF	0.0000	128.8000	0.0000	0.00000	0.00000	0.00000	0.000000	56.318297	0.000000
9 LUL	0.0000	92.9000	0.0000	0.00000	0.00000	0.00000	0.000000	-2.405246	0.000000
10 LLL	0.0000	48.6500	0.0000	0.00000	0.00000	0.00000	0.000000	-12.215669	0.000000
11 LF	0.0000	128.8000	0.0000	0.00000	0.00000	0.00000	0.000000	56.318297	0.000000
12 RUA	0.0000	24.5000	0.0000	0.00000	0.00000	0.00000	0.000000	-6.917594	0.000000
13 RLA	0.0000	85.0000	0.0000	0.00000	0.00000	0.00000	0.000000	-34.722447	0.000000
14 LUA	0.0000	24.5000	0.0000	0.00000	0.00000	0.00000	0.000000	-6.917594	0.000000
15 LLA	0.0000	85.0000	0.0000	0.00000	0.00000	0.00000	0.000000	-34.722447	0.000000
16 VEH	0.0000	0.0000	0.0000	0.00000	0.00000	0.00000	0.000000	0.000000	0.000000

SEGMENT	(INERTIAL) LINEAR POSITION (IN.) X	Y	Z	(INERTIAL) LINEAR VELOCITY (IN./SEC.) X	Y	Z	(INERTIAL) LINEAR ACCELERATIONS (G'S) X	Y	Z
1 LT	14.3810	0.0000	-13.7500	0.00000	0.00000	0.00000	0.017822	0.000000	-0.088444
2 CT	13.1607	0.0000	-19.0719	0.00000	0.00000	0.00000	0.114863	0.000000	-0.110519
3 UT	11.3138	0.0000	-26.9380	0.00000	0.00000	0.00000	-0.038031	0.000000	-0.075446
4 N	9.2835	0.0000	-35.5314	0.00000	0.00000	0.00000	-0.042274	0.000000	-0.074372
5 H	7.7752	0.0000	-41.8334	0.00000	0.00000	0.00000	-0.047117	0.000000	-0.073212
6 RUL	22.9407	3.4200	-14.4893	0.00000	0.00000	0.00000	0.041548	0.000000	-0.039498
7 RLL	38.1602	3.4200	-10.3904	0.00000	0.00000	0.00000	-0.100994	0.000000	0.188268
8 RF	48.1272	3.4200	-4.4560	0.00000	0.00000	0.00000	-0.187590	0.000000	-0.183587
9 LUL	22.9407	-3.4200	-14.4893	0.00000	0.00000	0.00000	0.041548	0.000000	-0.039498
10 LLL	38.1602	-3.4200	-10.3904	0.00000	0.00000	0.00000	-0.100994	0.000000	0.188268
11 LF	48.1272	-3.4200	-4.4560	0.00000	0.00000	0.00000	-0.187590	0.000000	-0.183587
12 RUA	12.3416	6.2400	-27.1319	0.00000	0.00000	0.00000	-0.114274	0.000000	-0.038215
13 RLA	22.7581	6.2400	-21.4852	0.00000	0.00000	0.00000	-0.266915	0.000000	0.736709
14 LUA	12.3416	-6.2400	-27.1319	0.00000	0.00000	0.00000	-0.114274	0.000000	-0.038215
15 LLA	22.7581	-6.2400	-21.4852	0.00000	0.00000	0.00000	-0.266915	0.000000	0.736709
16 VEH	0.0000	0.0000	0.0000	0.00000	0.00000	0.00000	0.000000	0.000000	0.000000

SEGMENT		(INERTIAL) U1 ARRAY (IN./SEC.**2) EXTERNAL LINEAR ACCELERATIONS X	Y	Z	(LOCAL) U2 ARRAY (RAD/SEC.**2) EXTERNAL ANGULAR ACCELERATIONS X	Y	Z	KINETIC ENERGY (LB.- IN.) LINEAR	ANGULAR	TOTAL
1	LT	-0.1289D+03	0.0000D+00	-0.1135D+04	0.00000D+00	-0.48015D+02	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
2	CT	0.0000D+00	0.0000D+00	0.3861D+03	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
3	UT	0.6940D+02	0.0000D+00	0.3701D+03	0.00000D+00	-0.31881D+01	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
4	N	0.0000D+00	0.0000D+00	0.3861D+03	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
5	H	0.7822D+02	0.0000D+00	0.3680D+03	-0.13304D-18	-0.28721D+00	0.30851D-18	0.00000D+00	0.00000D+00	0.00000D+00
6	RUL	-0.5309D+02	0.0000D+00	-0.1198D+03	0.85493D-17	0.21827D+02	0.12373D-14	0.00000D+00	0.00000D+00	0.00000D+00
7	RLL	0.0000D+00	0.0000D+00	0.3861D+03	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
8	RF	-0.9511D+01	0.0000D+00	-0.5210D+03	0.00000D+00	-0.17610D+03	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
9	LUL	-0.5309D+02	0.0000D+00	-0.1198D+03	0.85493D-17	0.21827D+02	0.12373D-14	0.00000D+00	0.00000D+00	0.00000D+00
10	LLL	0.0000D+00	0.0000D+00	0.3861D+03	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
11	LF	-0.9511D+01	0.0000D+00	-0.5210D+03	0.00000D+00	-0.17610D+03	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
12	RUA	0.0000D+00	0.0000D+00	0.3861D+03	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
13	RLA	0.0000D+00	0.0000D+00	0.3861D+03	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
14	LUA	0.0000D+00	0.0000D+00	0.3861D+03	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
15	LLA	0.0000D+00	0.0000D+00	0.3861D+03	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00	0.00000D+00
							TOTAL BODY KINETIC ENERGY	0.00000D+00	0.00000D+00	0.00000D+00

JOINT		IPIN	(INERTIAL) JOINT FORCES (LB.) X	Y	Z	(INERTIAL) JOINT TORQUES (IN. LB.) X	Y	Z	RELATIVE ANGULAR VELOCITY (RAD/SEC.)
1	P	0	-0.177D+02	0.000D+00	-0.100D+03	0.0000D+00	0.0000D+00	0.0000D+00	0.000
2	W	0	-0.192D+02	0.000D+00	-0.859D+02	0.0000D+00	0.0000D+00	0.0000D+00	0.000
3	NP	0	-0.312D+01	0.000D+00	-0.158D+02	0.0000D+00	0.0000D+00	0.0000D+00	0.000
4	HP	0	-0.298D+01	0.000D+00	-0.122D+02	0.0000D+00	0.0000D+00	0.0000D+00	0.000
5	RH	0	0.274D+01	0.000D+00	0.853D+00	0.0000D+00	0.0000D+00	0.0000D+00	0.000
6	RK	1	-0.132D+01	0.000D+00	-0.550D+01	0.0000D+00	0.0000D+00	0.0000D+00	0.000
7	RA	0	-0.339D+00	0.000D+00	0.242D+01	0.0000D+00	0.0000D+00	0.0000D+00	0.000
8	LH	0	0.274D+01	0.000D+00	0.853D+00	0.0000D+00	0.0000D+00	0.0000D+00	0.000
9	LK	1	-0.132D+01	0.000D+00	-0.550D+01	0.0000D+00	0.0000D+00	0.0000D+00	0.000
10	LA	0	-0.339D+00	0.000D+00	0.242D+01	0.0000D+00	0.0000D+00	0.0000D+00	0.000
11	RS	0	-0.221D+01	0.000D+00	-0.731D+01	0.0000D+00	0.0000D+00	0.0000D+00	0.000
12	RE	1	-0.158D+01	0.000D+00	-0.155D+01	0.0000D+00	0.0000D+00	0.0000D+00	0.000
13	LS	0	-0.221D+01	0.000D+00	-0.731D+01	0.0000D+00	0.0000D+00	0.0000D+00	0.000
14	LE	1	-0.158D+01	0.000D+00	-0.155D+01	0.0000D+00	0.0000D+00	0.0000D+00	0.000

HARNESS BELT RESULTS FOR TIME = 0.000 MSEC. PAGE 22

POINT NO.	POINT INDEX	SEGMENT NO.	LENGTH (IN.)	BELT STRAIN ENERGY LOSS (IN. LB.)	(LOCAL OR ELLIPSOID) REFERENCE POINT (IN.) X	Y	Z	(INERTIAL) BELT FORCES (LB.) X	Y	Z	PENETRATION ENERGY LOSS (IN. LB.)
BELT NO. 1 OF HARNESS NO. 1											
1	1	16	0.000	0.000	13.000	8.000	-10.300	0.000	0.000	0.000	0.000
2	2	1	4.124	0.000	-1.178	7.075	-0.781	0.000	0.000	0.000	0.000
3	3	1	1.402	0.000	-0.029	6.795	-1.534	0.000	0.000	0.000	0.000
4	4	1	1.574	0.000	0.910	5.778	-2.283	0.000	0.000	0.000	0.000
5	5	1	3.779	0.000	2.228	2.355	-3.102	0.000	0.000	0.000	0.000
6	6	1	2.557	0.000	2.957	0.000	3.050	0.000	0.000	0.000	0.000
7	8	1	2.656	0.000	1.785	-2.325	-3.343	0.000	0.000	0.000	0.000
8	9	1	3.388	0.000	0.011	-5.145	-2.728	0.000	0.000	0.000	0.000
9	10	1	1.187	0.000	-0.880	-5.789	-2.282	0.000	0.000	0.000	0.000
10	11	1	1.940	0.000	-2.460	-6.098	-1.200	0.000	0.000	0.000	0.000
11	12	16	4.738	0.000	13.000	-8.000	-10.300	0.000	0.000	0.000	0.000
TOTAL BELT ENERGY LOSS				0.000							0.000
BELT NO. 2 OF HARNESS NO. 1											
12	13	16	0.000	0.000	13.000	-8.000	-10.300	0.000	0.000	0.000	0.000
13	14	1	4.748	0.000	-2.445	-6.101	-1.213	0.000	0.000	0.000	0.000
14	18	2	7.394	0.000	1.818	-5.439	-1.820	0.000	0.000	0.000	0.000
15	21	3	6.842	0.000	4.487	-0.133	3.734	0.000	0.000	0.000	0.000
16	22	3	6.406	0.000	4.421	3.319	-1.662	0.000	0.000	0.000	0.000
17	23	3	5.423	0.000	0.879	4.202	-5.672	0.000	0.000	0.000	0.000
18	27	16	10.829	0.000	0.000	5.000	-35.200	0.000	0.000	0.000	0.000
TOTAL BELT ENERGY LOSS				0.000							0.000
TOTAL HARNESS ENERGY LOSS				0.000							0.000

HPTURB ITER = 10 AT TIME = 16.000 MSEC. DELMAX = 0.010537 SCALE = 1.000000

HPTURB ITER = 10 AT TIME = 18.000 MSEC. DELMAX = 0.000232 SCALE = 1.000000

HPTURB ITER = 10 AT TIME = 19.000 MSEC. DELMAX = 0.009627 SCALE = 1.000000

HPTURB ITER = 10 AT TIME = 20.000 MSEC. DELMAX = 0.010050 SCALE = 1.000000

HPTURB ITER = 10 AT TIME = 21.000 MSEC. DELMAX = 0.010116 SCALE = 1.000000

HBPLAT TIME = 22.000 MSEC. NH,NB,NPTS NT= 1 2 8 181
NL(I)= 13 14 18 21 22 23 24 27
BB = 4.748 7.394 6.842 6.406 5.423 0.491 10.338

HPTURB ITER = 10 AT TIME = 22.000 MSEC. DELMAX = 0.012849 SCALE = 1.000000

HPTURB ITER = 10 AT TIME = 23.000 MSEC. DELMAX = 0.011517 SCALE = 1.000000

HPTURB ITER = 10 AT TIME = 24.000 MSEC. DELMAX = 0.011234 SCALE = 1.000000

HPTURB ITER = 10 AT TIME = 25.000 MSEC. DELMAX = 0.011569 SCALE = 1.000000

HPTURB ITER = 10 AT TIME = 26.000 MSEC. DELMAX = 0.012320 SCALE = 1.000000

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HPTURB ITER =  10 AT TIME =  28.000 MSEC.  DELMAX =  0.010639  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  29.000 MSEC.  DELMAX =  0.012461  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  30.000 MSEC.  DELMAX =  0.014987  SCALE =  1.000000

HBPLAY TIME =    31.000 MSEC. NH,NB,NPTS NT=     1     2     7   181
NL(I)=      13      14      18      21      22      24      27
BB   =         4.748   7.394   6.842   6.406   5.572  10.679

HPTURB ITER =  10 AT TIME =  31.000 MSEC.  DELMAX =  0.021341  SCALE =  1.000000

HBPLAY TIME =    32.000 MSEC. NH,NB,NPTS NT=     1     2     8   181
NL(I)=      13      14      18      21      22      23      24      27
BB   =         4.748   7.394   6.842   6.406   5.066   0.280  10.928

HPTURB ITER =  10 AT TIME =  32.000 MSEC.  DELMAX =  0.016547  SCALE =  1.000000

HBPLAY TIME =    33.000 MSEC. NH,NB,NPTS NT=     1     2     7   181
NL(I)=      13      14      18      21      22      23      27
BB   =         4.748   7.394   6.842   6.406   5.066  11.186

HPTURB ITER =  10 AT TIME =  33.000 MSEC.  DELMAX =  0.036770  SCALE =  1.000000

HBPLAY TIME =    34.000 MSEC. NH,NB,NPTS NT=     1     2     8   181
NL(I)=      13      14      18      21      22      23      24      27
BB   =         4.748   7.394   6.842   6.406   5.066   0.289  10.896

HPTURB ITER =  10 AT TIME =  34.000 MSEC.  DELMAX =  0.041013  SCALE =  1.000000

HBPLAY TIME =    35.000 MSEC. NH,NB,NPTS NT=     1     2     7   181
NL(I)=      13      14      18      21      22      24      27
BB   =         4.748   7.394   6.842   6.406   5.216  11.035

HPTURB ITER =  10 AT TIME =  35.000 MSEC.  DELMAX =  0.021221  SCALE =  1.000000

HBPLAY TIME =    36.000 MSEC. NH,NB,NPTS NT=     1     2     8   181
NL(I)=      13      14      18      21      22      23      24      27
BB   =         4.748   7.394   6.842   6.406   4.847   0.195  11.210

HPTURB ITER =  10 AT TIME =  36.000 MSEC.  DELMAX =  0.012648  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  37.000 MSEC.  DELMAX =  0.015643  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  38.000 MSEC.  DELMAX =  0.011152  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  39.000 MSEC.  DELMAX =  0.014391  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  40.000 MSEC.  DELMAX =  0.017690  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  41.000 MSEC.  DELMAX =  0.015081  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  42.000 MSEC.  DELMAX =  0.017005  SCALE =  1.000000

HBPLAY TIME =    43.000 MSEC. NH,NB,NPTS NT=     1     2     7   181
NL(I)=      13      14      18      21      22      24      27
BB   =         4.748   7.394   6.842   6.406   4.910  11.342
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HPTURB ITER =  10 AT TIME =  43.000 MSEC.  DELMAX =  0.053120  SCALE =  1.000000

HBPLAT TIME =    44.000 MSEC. NH,NB,NPTS NT=     1     2     8   181
NL(I)=      13      14      18      21      22      23      24      27
BB   =        4.748   7.394   6.842   6.406   4.496   0.075  11.681

HPTURB ITER =  10 AT TIME =  44.000 MSEC.  DELMAX =  0.013932  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  45.000 MSEC.  DELMAX =  0.012874  SCALE =  1.000000

HBPLAT TIME =    46.000 MSEC. NH,NB,NPTS NT=     1     2     7   181
NL(I)=      13      18      21      22      23      24      27
BB   =       12.143   6.842   6.406   4.496   0.055  11.701

HPTURB ITER =  10 AT TIME =  46.000 MSEC.  DELMAX =  0.014891  SCALE =  1.000000

HBPLAT TIME =    47.000 MSEC. NH,NB,NPTS NT=     1     1    10   103
NL(I)=       1       3       4       5       6       8       9      10      11      12
BB   =        5.526   1.574   3.779   2.557   2.658   3.388   1.187   1.940   4.738

HPTURB ITER =  10 AT TIME =  47.000 MSEC.  DELMAX =  0.018982  SCALE =  1.000000

HBPLAT TIME =    48.000 MSEC. NH,NB,NPTS NT=     1     2     6   181
NL(I)=      13      18      21      22      24      27
BB   =       12.143   6.842   6.406   4.534  11.718

HPTURB ITER =  10 AT TIME =  48.000 MSEC.  DELMAX =  0.064777  SCALE =  1.000000

HBPLAT TIME =    49.000 MSEC. NH,NB,NPTS NT=     1     2     7   181
NL(I)=      13      18      21      22      23      24      27
BB   =       12.143   6.842   6.406   4.192   0.045  12.015

HPTURB ITER =  10 AT TIME =  49.000 MSEC.  DELMAX =  0.010077  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  50.000 MSEC.  DELMAX =  0.010283  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  51.000 MSEC.  DELMAX =  0.012303  SCALE =  1.000000

HBPLAT TIME =    52.000 MSEC. NH,NB,NPTS NT=     1     2     6   181
NL(I)=      13      18      21      22      24      27
BB   =       12.143   6.842   6.406   4.222  12.029

HPTURB ITER =  10 AT TIME =  52.000 MSEC.  DELMAX =  0.055553  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  53.000 MSEC.  DELMAX =  0.035462  SCALE =  1.000000

HBPLAT TIME =    54.000 MSEC. NH,NB,NPTS NT=     1     1     9   103
NL(I)=       1       3       4       5       6       8       9      10      12
BB   =        5.526   1.574   3.779   2.557   2.050   3.308   1.187   6.676

HPTURB ITER =  10 AT TIME =  54.000 MSEC.  DELMAX =  0.024287  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  55.000 MSEC.  DELMAX =  0.015678  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  56.000 MSEC.  DELMAX =  0.011486  SCALE =  1.000000

HBPLAT TIME =    57.000 MSEC. NH,NB,NPTS NT=     1     2     7   181
NL(I)=      13      18      19      21      22      24      27
BB   =       12.143   1.887   4.055   6.406   3.880  12.372
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HPTURB ITER =  10 AT TIME =  57.000 MSEC.  DELMAX =  0.385300  SCALE =  0.259532

HBPLAT TIME =    58.000 MSEC. NH,NB,NPTS NT=    1    2    8   181
NL(I)=     13      16      19      20      21      22      24      27
BB   =        12.143   1.887   1.817   3.139   6.406   3.880  12.372

HPTURB ITER =  10 AT TIME =  58.000 MSEC.  DELMAX =  0.443658  SCALE =  0.225399

HBPLAT TIME =    59.000 MSEC. NH,NB,NPTS NT=    1    2    9   181
NL(I)=     13      16      18      19      20      21      22      24      27
BB   =         7.889   4.253   1.887   1.817   3.139   6.406   3.874  12.277

HPTURB ITER =  10 AT TIME =  59.000 MSEC.  DELMAX =  0.052001  SCALE =  1.000000

HBPLAT TIME =    60.000 MSEC. NH,NB,NPTS NT=    1    2    8   181
NL(I)=     13      18      19      20      21      22      24      27
BB   =        12.143   1.887   1.817   3.139   6.406   4.086  12.185

HPTURB ITER =  10 AT TIME =  60.000 MSEC.  DELMAX =  0.057808  SCALE =  1.000000

HBPLAT TIME =    61.000 MSEC. NH,NB,NPTS NT=    1    2    7   181
NL(I)=     13      18      20      21      22      24      27
BB   =        12.143   3.703   3.139   6.406   4.156  12.096

HPTURB ITER =  10 AT TIME =  61.000 MSEC.  DELMAX =  0.015872  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  62.000 MSEC.  DELMAX =  0.022130  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  63.000 MSEC.  DELMAX =  0.015337  SCALE =  1.000000

HBPLAT TIME =    64.000 MSEC. NH,NB,NPTS NT=    1    2    6   181
NL(I)=     13      18      20      21      22      27
BB   =        12.143   3.703   3.139   6.406  16.252

HPTURB ITER =  10 AT TIME =  64.000 MSEC.  DELMAX =  0.011067  SCALE =  1.000000

HBPLAT TIME =    66.000 MSEC. NH,NB,NPTS NT=    1    1    8   103
NL(I)=      1       3       4       5       6       8       9      12
BB   =         5.526   1.574   3.779   2.557   2.656   3.388   7.865

HPTURB ITER =  10 AT TIME =  67.000 MSEC.  DELMAX =  0.011853  SCALE =  1.000000

HPTURB ITER =  10 AT TIME =  69.000 MSEC.  DELMAX =  0.013454  SCALE =  1.000000

DIFF CONV. TEST    72.000   N    ANG VEL    22.55      0.2652E-02  0.1176E-03  0.1000E-03  0.1000E-03  0.1000E-03

TEST FAILED AT TIME =   0.072000 FOR H =   0.001000

DIFF CONV. TEST    73.000   N    ANG VEL    23.86      0.3624E-02  0.1518E-03  0.1000E-03  0.1000E-03  0.1000E-03

TEST FAILED AT TIME =   0.073000 FOR H =   0.001000

DIFF CONV. TEST    74.000   N    ANG VEL    26.11      0.3030E-02  0.1164E-03  0.1000E-03  0.1000E-03  0.1000E-03

TEST FAILED AT TIME =   0.074000 FOR H =   0.001000
```

SEGMENT	(INERTIAL) ANGULAR ROTATION (DEG) YAW	PITCH	ROLL	(LOCAL) ANGULAR VELOCITY (RAD/SEC.) X	Y	Z	(LOCAL) ANGULAR ACCELERATION (RAD/SEC.**2) X	Y	Z
1 LT	10.9078	40.4616	-2.5237	-3.50101	6.77176	3.01702	-712.525841	-923.312215	-344.896206
2 CT	5.8648	8.3877	-35.0629	-28.78011	38.13662	26.32712	2669.823703	4863.705052	714.436129
3 UT	22.6603	16.1876	4.2073	-4.55898	-8.33212	11.28470	-833.169019	-740.536145	24.730107
4 N	9.4134	-28.3218	9.0212	3.10468	-11.10456	11.62142	-474.529280	-2359.202265	525.452347
5 H	-14.7037	-82.0894	29.6482	16.06835	-58.33883	6.84809	321.909908	-351.659929	252.225950
6 RUL	11.0166	100.4701	10.5736	-0.26043	-3.94123	-2.59118	-82.766870	-780.201793	66.972957
7 RLL	-2.0078	53.9069	-3.2449	-2.05452	9.15294	-1.60027	12.275725	-89.117047	79.212811
8 RF	-1.2125	146.0433	2.4774	3.41634	1.03537	-1.56581	-92.295830	747.087281	-23.919556
9 LUL	4.3686	101.7927	4.4680	-0.37199	-3.33541	-0.44435	-290.296221	-679.956631	528.292676
10 LLL	-0.9289	45.3497	-1.2961	-0.57596	5.97768	0.06395	278.790377	-4.508498	528.778614
11 LF	-0.5610	155.8698	1.6050	1.79230	0.13205	-0.59660	-177.520464	1209.576330	196.625307
12 RUA	-75.0950	70.5657	-80.2833	-6.23227	-4.14211	-1.63054	244.397026	-3261.631891	-168.345676
13 RLA	-21.0534	51.2884	-31.6271	-6.16955	1.21106	1.79408	113.635226	2487.822774	-303.100899
14 LUA	-17.8558	62.4794	-23.3643	-2.95595	-0.00123	5.46149	322.014086	-2636.161399	686.201217
15 LLA	-16.0460	60.3973	-21.7744	-2.73681	-15.25083	5.57354	441.700349	4146.746559	916.611615
16 VEH	0.0000	0.0000	0.0000	0.00000	0.00000	0.00000	0.000000	0.000000	0.000000

SEGMENT	(INERTIAL) LINEAR POSITION (IN.) X	Y	Z	(INERTIAL) LINEAR VELOCITY (IN./SEC.) X	Y	Z	(INERTIAL) LINEAR ACCELERATIONS (G'S) X	Y	Z
1 LT	6.0377	0.0702	-13.0395	-334.65671	-2.92122	-92.21272	1.118456	-3.410755	-24.241372
2 CT	3.5221	-1.5083	-17.2697	-403.89532	-63.36301	-39.55188	-7.411998	0.308363	-23.341359
3 UT	1.5893	-2.7194	-24.7657	-399.28403	-115.11128	-20.63141	-6.535068	3.408464	-20.077252
4 N	-0.4641	-2.8941	-33.1682	-319.46157	-121.58500	-38.64033	16.009901	-4.901599	-22.093312
5 H	4.8868	-1.0902	-36.0984	-178.47710	-89.63431	287.80272	-29.256214	-10.703850	8.134182
6 RUL	13.6013	3.3950	-14.9332	-345.17072	-4.32318	-59.80904	2.896528	-1.986709	-14.025632
7 RLL	29.0739	3.6383	-12.6201	-300.76311	12.84266	-73.16830	3.883535	0.620604	6.154392
8 RF	39.4966	3.6714	-8.4455	-258.02278	23.08009	-137.61724	0.173190	0.801745	-0.915789
9 LUL	16.0441	-3.3466	-14.9210	-314.88548	2.85212	-60.25035	6.374569	3.060291	-3.334002
10 LLL	29.7934	-3.3024	-12.0614	-278.61100	10.63011	-57.36381	9.150247	6.479980	13.521811
11 LF	39.2761	-3.3229	-7.6097	-244.93381	11.69052	-92.38042	4.608846	0.184379	1.561647
12 RUA	3.1574	3.4023	-29.0240	-426.99852	-109.61718	-32.04897	-2.643643	6.759738	8.506879
13 RLA	15.1710	5.9986	-24.3530	-429.54688	-25.03050	-48.34975	23.116917	3.958924	9.665922
14 LUA	7.1965	-8.0306	-27.9271	-282.38560	-78.35066	-29.72059	-9.173676	2.086369	27.950874
15 LLA	19.2594	-6.2444	-21.8664	-343.80786	-23.50199	71.96752	11.107169	-20.329519	-12.311190
16 VEH	-12.3548	0.0000	0.0000	-308.87040	0.00000	0.00000	0.000000	0.000000	0.000000

SEGMENT		(INERTIAL) U1 ARRAY (IN./SEC.**2) EXTERNAL LINEAR ACCELERATIONS X	Y	Z	(LOCAL) U2 ARRAY (RAD/SEC.**2) EXTERNAL ANGULAR ACCELERATIONS X	Y	Z	KINETIC ENERGY (LB.- IN.) LINEAR	ANGULAR	TOTAL
1	LT	-0.3009D+03	0.1559D+02	-0.2698D+05	-0.60308D+03	-0.27927D+04	-0.22971D+03	0.54266D+04	0.41308D+02	0.54679D+04
2	CT	0.2569D+03	-0.5220D+03	-0.6204D+03	0.88420D+04	0.83818D+04	0.71444D+03	0.28620D+04	0.54259D+03	0.34046D+04
3	UT	-0.6894D+03	-0.2430D+03	0.4419D+03	-0.69029D+03	-0.15455D+03	0.16513D+02	0.12032D+05	0.28218D+03	0.12314D+05
4	N	0.0000D+00	0.0000D+00	0.3861D+03	-0.26984D+04	0.10411D+05	0.52545D+03	0.50402D+03	0.33066D+01	0.50733D+03
5	H	0.0000D+00	0.0000D+00	0.3861D+03	-0.35125D+03	0.92855D+03	0.25223D+03	0.18467D+04	0.56365D+03	0.24104D+04
6	RUL	0.1244D+03	-0.7761D+01	0.5426D+02	-0.23939D+01	0.52884D+02	-0.10354D+01	0.36122D+04	0.16567D+02	0.36287D+04
7	RLL	0.0000D+00	0.0000D+00	0.3861D+03	-0.82176D+01	-0.24413D+03	-0.15598D+03	0.12134D+04	0.22031D+02	0.12355D+04
8	RF	0.0000D+00	0.0000D+00	0.3861D+03	-0.18022D+03	0.11120D+04	-0.75866D+03	0.23167D+03	0.27743D+00	0.23195D+03
9	LUL	-0.1221D+04	0.2472D+04	0.2645D+04	-0.70853D+03	-0.12076D+04	-0.31901D+03	0.30251D+04	0.11362D+02	0.30365D+04
10	LLL	0.0000D+00	0.0000D+00	0.3861D+03	-0.66486D+01	-0.17362D+03	-0.14022D+03	0.10259D+04	0.89964D+01	0.10349D+04
11	LF	0.0000D+00	0.0000D+00	0.3861D+03	-0.20969D+03	0.81201D+03	-0.72214D+02	0.18487D+03	0.69768D-01	0.18494D+03
12	RUA	0.0000D+00	0.0000D+00	0.3861D+03	-0.44483D+02	-0.70077D+04	0.79493D+03	0.14022D+04	0.49151D+01	0.14071D+04
13	RLA	-0.8603D+02	-0.4004D+01	0.7761D+03	0.31299D+02	0.34441D+04	-0.57371D+02	0.14312D+04	0.66593D+01	0.14379D+04
14	LUA	0.0000D+00	0.0000D+00	0.3861D+03	-0.16398D+03	-0.90273D+03	0.56251D+02	0.62271D+03	0.11476D+01	0.62386D+03
15	LLA	-0.9690D+04	-0.7116D+04	-0.3749D+04	0.20275D+04	0.70096D+04	0.12476D+04	0.94712D+03	0.40319D+02	0.98744D+03

TOTAL BODY KINETIC ENERGY

LINEAR	ANGULAR	TOTAL
0.36368D+05	0.15454D+04	0.37913D+05

JOINT		IPIN	(INERTIAL) JOINT FORCES (LB.) X	Y	Z	(INERTIAL) JOINT TORQUES (IN. LB.) X	Y	Z	RELATIVE ANGULAR VELOCITY (RAD/SEC.)
1	P	0	-0.478D+03	0.156D+03	-0.120D+04	0.1437D+04	0.1730D+04	-0.4588D+03	47 900
2	W	0	-0.373D+03	0.134D+03	-0.919D+03	-0.2162D+04	-0.6568D+03	0.7903D+03	63.460
3	NP	0	-0.296D+03	-0.144D+03	0.914D+01	-0.2178D+03	0.5526D+03	0.5465D+02	4.653
4	HP	0	-0.349D+03	-0.128D+03	0.851D+02	-0.8035D+02	0.2872D+03	0.4001D+02	48.641
5	RH	0	0.966D+02	-0.374D+02	-0.276D+03	0.1540D+01	0.6042D+02	0.1998D+02	11.110
6	RK	1	0.383D+02	0.731D+01	0.463D+02	-0.9820D+01	-0.7377D+02	0.4208D+02	13.094
7	RA	0	0.360D+00	0.125D+01	-0.398D+01	0.6057D+01	0.4563D+02	0.6082D+01	8.104
8	LH	0	0.316D+03	0.174D+01	-0.108D+03	-0.1049D+02	0.5690D+02	0.2195D+02	10.800
9	LK	1	0.990D+02	0.636D+02	0.123D+03	-0.1739D+03	-0.4959D+02	0.2365D+03	9.313
10	LA	0	0.958D+01	0.342D+00	0.117D+01	0.8697D+01	0.3333D+02	0.3159D+01	8.037
11	RS	0	0.123D+03	0.609D+02	0.770D+02	0.2329D+02	-0.3963D+02	0.2492D+02	9.125
12	RE	1	0.138D+03	0.234D+02	0.465D+02	-0.5987D+02	0.1090D+04	-0.4321D+03	5.353
13	LS	0	0.163D+03	0.378D+00	0.134D+03	-0.7896D+01	-0.5782D+02	0.3755D+02	12.112
14	LE	1	0.214D+03	-0.112D+02	-0.153D+02	-0.1860D+03	0.1440D+03	0.2989D+03	15.250

POSTPROCESSOR CONTROL PARAMETERS

	BIC & BSI POINT	CSI POINT
N 11	3	1

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

VEHICLE ACCELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

POINT TOTAL ACCELERATION (G'S)

TIME	POINT (0.00, 0.00, 0.00) ON SEGMENT NO. 3 - UT IN UT REFERENCE				POINT (0.00, 0.00, 0.00) ON SEGMENT NO. -5 - H ACCELEROMETER (10)				POINT (0.00, 0.00, 0.00) ON SEGMENT NO. 5 - H IN VEH REFERENCE			
(MSEC)	X	Y	Z	RES	X	Y	Z	RES	X	Y	Z	RES
0.000	-0.020	0.000	-0.082	0.084	-0.262	0.000	0.890	0.928	-0.047	0.000	-0.073	0.087
2.000	-0.014	0.000	-0.107	0.108	-0.260	0.000	0.865	0.903	-0.051	0.000	-0.098	0.111
4.000	-0.007	0.000	-0.179	0.179	-0.258	0.000	0.793	0.834	-0.087	0.000	-0.168	0.181
6.000	-0.006	-0.003	-0.247	0.247	-0.289	0.000	0.725	0.774	-0.093	0.000	-0.232	0.250
8.000	-0.019	-0.012	-0.314	0.315	-0.308	-0.002	0.658	0.725	-0.144	-0.002	-0.289	0.323
10.000	-0.081	-0.023	-0.386	0.391	-0.379	-0.005	0.586	0.698	-0.233	-0.005	-0.342	0.413
12.000	-0.091	-0.032	-0.464	0.474	-0.475	-0.008	0.507	0.695	-0.344	-0.008	-0.396	0.525
14.000	-0.099	-0.023	-0.547	0.556	-0.487	-0.006	0.425	0.646	-0.375	-0.006	-0.474	0.604
16.000	-0.132	-0.024	-0.623	0.638	-0.506	-0.007	0.348	0.614	-0.411	-0.007	-0.544	0.682
18.000	-0.111	-0.005	-0.719	0.727	-0.510	-0.003	0.253	0.570	-0.437	-0.003	-0.635	0.771
20.000	-0.133	-0.001	-0.791	0.802	-0.525	-0.002	0.181	0.555	-0.468	-0.002	-0.702	0.844
22.000	-0.197	-0.016	-0.854	0.876	-0.551	-0.005	0.119	0.564	-0.509	-0.006	-0.756	0.911
24.000	-0.382	-0.063	-1.317	1.373	-0.662	-0.179	-0.342	0.767	-0.721	-0.179	-1.179	1.395
26.000	-0.390	-0.112	-1.296	1.358	-0.685	-0.231	-0.314	0.788	-0.739	-0.231	-1.147	1.384
28.000	-0.357	0.556	-1.166	1.340	-0.682	-0.014	-0.181	0.705	-0.705	-0.014	-1.019	1.239
30.000	-0.438	0.816	-1.246	1.553	-0.702	0.035	-0.256	0.748	-0.742	0.035	-1.087	1.317
32.000	-2.733	-0.835	-0.461	2.895	-1.271	-0.218	0.578	1.412	-1.106	-0.220	-0.149	1.137
34.000	-2.186	-0.420	-0.403	2.263	-1.208	-0.216	0.667	1.397	-1.025	-0.219	-0.076	1.051
36.000	-3.145	-0.474	-0.313	3.196	-1.481	-0.353	0.849	1.743	-1.252	-0.357	0.159	1.312
38.000	-4.178	-0.580	-1.221	4.391	-1.843	-0.709	0.133	1.979	-1.769	-0.710	-0.467	1.963
40.000	-5.137	0.364	-1.250	5.299	-2.004	-0.530	0.280	2.092	-1.897	-0.533	-0.297	1.993
42.000	-6.838	1.397	-2.254	7.334	-2.388	-0.543	-0.390	2.479	-2.417	-0.540	-0.885	2.630
44.000	-14.419	-3.743	0.830	14.920	-4.097	-1.242	3.893	5.787	-3.227	-1.300	3.624	5.024
46.000	-16.621	-1.760	-0.518	16.722	-4.375	-1.075	3.474	5.689	-3.633	-1.143	3.226	4.991
48.000	-21.535	0.772	0.632	21.558	-4.411	-0.608	5.515	7.088	-3.372	-0.744	5.190	6.234
50.000	-41.704	-14.755	6.467	44.707	-8.393	-3.295	18.145	20.262	-5.470	-3.858	18.124	19.321
52.000	-46.097	-12.754	8.809	48.633	-8.850	-2.015	24.198	25.844	-5.684	-2.998	24.033	24.877
54.000	-59.506	-18.177	14.142	63.807	-11.972	-2.812	40.775	42.589	-8.224	-4.949	40.493	41.615
56.000	-60.433	-15.422	13.472	63.808	-11.763	-2.643	48.226	49.710	-9.706	-5.876	47.398	48.737
58.000	-73.471	-17.978	-2.410	75.677	-11.839	-4.818	45.094	46.871	-12.593	-8.610	43.319	45.927
60.000	-93.922	-15.685	14.909	96.382	-10.687	1.243	84.829	85.716	-16.338	-5.515	82.414	84.752
62.000	-39.398	-7.543	-3.263	40.247	-8.458	0.385	50.073	50.783	-16.781	-5.749	46.585	49.848
64.000	-13.416	-3.242	-10.799	17.525	-4.985	0.413	34.219	34.583	-13.561	-4.374	30.511	33.674
66.000	2.837	-2.587	-20.041	20.406	-4.398	-0.971	17.138	17.719	-9.978	-3.581	13.198	16.979
68.000	12.171	-3.027	-29.353	31.921	-6.574	-2.288	10.559	12.647	-10.367	-3.898	5.106	12.195
70.000	12.817	-4.431	-27.755	30.891	-6.991	-2.721	11.612	13.993	-11.904	-4.658	4.693	13.617
72.000	8.827	-2.877	-26.335	27.924	-5.142	-2.318	12.679	13.876	-11.519	-4.665	5.172	13.461
74.000	3.362	-1.720	-32.445	32.664	-5.688	-2.458	13.892	15.211	-13.307	-5.198	4.223	14.897
76.000	-2.984	1.218	-32.702	32.861	-6.355	-2.850	21.202	22.317	-19.656	-7.488	6.458	22.003
78.000	-4.104	3.348	-30.967	31.417	-5.758	-2.791	26.452	27.215	-24.295	-9.144	7.173	26.932
80.000	-0.706	4.868	-21.526	22.081	-3.903	-2.154	32.157	32.464	-29.256	-10.704	8.134	32.197

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD
VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

POINT REL. VELOCITY (IN./SEC.)

TIME (MSEC)	POINT (0.00, 0.00, 0.00) ON SEGMENT NO. 3 - UT IN VEH REFERENCE X	Y	Z	RES	POINT (0.00, 0.00, 0.00) ON SEGMENT NO. 5 - H IN VEH REFERENCE X	Y	Z	RES	POINT (0.00, 0.00, 0.00) ON SEGMENT NO. 5 - H IN UT REFERENCE X	Y	Z	RES
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.000	0.357	0.000	-0.064	0.362	0.349	0.000	-0.062	0.355	-0.008	0.000	0.000	0.008
4.000	1.482	0.000	-0.168	1.491	1.463	0.000	-0.163	1.472	-0.020	0.000	0.000	0.020
6.000	3.368	-0.002	-0.329	3.384	3.332	0.000	-0.320	3.347	-0.037	0.002	0.000	0.037
8.000	6.010	-0.010	-0.534	6.034	5.944	-0.002	-0.519	5.967	-0.067	0.008	0.000	0.068
10.000	9.392	-0.024	-0.792	9.425	9.275	-0.005	-0.764	9.307	-0.120	0.019	0.000	0.121
12.000	13.502	-0.048	-1.096	13.546	13.296	-0.010	-1.048	13.338	-0.211	0.038	0.000	0.214
14.000	18.360	-0.073	-1.462	18.418	18.037	-0.016	-1.386	18.090	-0.332	0.057	0.000	0.336
16.000	23.966	-0.096	-1.885	24.040	23.526	-0.022	-1.782	23.593	-0.452	0.074	-0.001	0.458
18.000	30.318	-0.118	-2.369	30.411	29.761	-0.028	-2.239	29.845	-0.572	0.090	-0.001	0.579
20.000	37.426	-0.138	-2.913	37.539	36.747	-0.034	-2.754	36.851	-0.697	0.104	-0.001	0.704
22.000	45.254	-0.175	-3.495	45.389	44.477	-0.043	-3.312	44.601	-0.798	0.130	-0.001	0.808
24.000	53.624	-0.222	-4.417	53.806	52.814	-0.157	-4.225	52.983	-0.832	0.065	-0.001	0.835
26.000	62.779	-0.294	-5.297	63.002	61.919	-0.307	-5.069	62.128	-0.885	-0.012	0.003	0.885
28.000	72.709	-0.176	-6.137	72.968	71.793	-0.419	-5.907	72.037	-0.945	-0.242	0.010	0.975
30.000	83.404	0.352	-6.915	83.690	82.451	-0.398	-6.666	82.721	-0.986	-0.749	0.019	1.238
32.000	94.080	0.535	-7.240	94.360	93.727	-0.423	-7.110	93.997	-0.378	-0.957	0.041	1.029
34.000	104.889	0.071	-7.234	105.138	105.604	-0.633	-7.308	105.859	0.710	-0.706	0.097	1.006
36.000	116.510	-0.408	-7.277	116.737	118.233	-0.984	-7.495	118.474	1.722	-0.585	0.197	1.830
38.000	127.722	-1.024	-7.102	127.923	131.308	-1.474	-7.573	131.533	3.590	-0.474	0.404	3.643
40.000	139.233	-1.201	-6.715	139.400	145.087	-1.867	-7.440	145.290	5.849	-0.719	0.720	5.937
42.000	149.450	-0.660	-6.479	149.592	158.571	-2.237	-7.528	158.765	9.079	-1.685	1.225	9.315
44.000	155.812	-0.836	-4.740	155.887	170.774	-2.712	-6.337	170.913	14.855	-2.108	2.198	15.163
46.000	157.720	-3.088	-1.115	157.754	181.675	-3.707	-3.283	181.743	23.690	-1.112	4.061	24.061
48.000	156.098	-4.584	3.913	156.213	191.901	-4.378	0.957	191.953	35.308	-0.762	6.593	35.927
50.000	141.126	-13.942	16.832	142.808	199.739	-6.636	13.452	200.301	57.525	5.185	12.814	59.163
52.000	122.195	-24.412	32.266	128.719	206.870	-9.011	29.910	209.017	82.311	11.324	21.803	85.900
54.000	94.373	-38.752	54.224	115.535	211.079	-12.280	56.971	218.976	112.157	18.960	37.279	119.701
56.000	63.940	-52.830	76.311	114.069	213.707	-16.371	91.124	232.899	141.171	23.877	58.599	154.873
58.000	27.937	-68.681	99.256	123.894	214.085	-21.715	126.806	249.767	171.680	26.531	86.244	193.948
60.000	-48.785	-89.387	132.584	167.178	209.556	-25.937	169.668	270.875	236.362	26.911	120.368	268.591
62.000	-77.547	-101.219	145.352	193.355	203.606	-30.570	209.855	293.988	252.303	25.298	154.604	296.984
64.000	-88.016	-107.303	145.939	201.393	199.040	-34.244	238.403	312.451	249.362	19.440	183.655	310.304
66.000	-87.056	-109.586	135.436	194.758	196.297	-37.048	254.173	323.279	237.429	13.587	207.586	315.873
68.000	-81.208	-110.824	115.623	179.570	193.532	-39.896	261.153	327.486	220.628	9.256	230.063	318.891
70.000	-73.848	-112.242	90.482	161.984	189.212	-43.176	264.497	328.061	200.518	6.748	252.981	322.881
72.000	-68.106	-113.520	68.202	148.919	183.289	-46.872	268.296	328.290	181.488	4.619	273.349	328.145
74.000	-67.903	-114.780	45.146	140.796	177.090	-50.470	271.958	328.435	167.906	1.761	295.644	340.002
76.000	-74.322	-116.052	20.340	139.197	166.505	-55.141	276.104	327.105	156.313	-2.407	320.292	358.408
78.000	-83.506	-116.413	-2.649	143.291	150.797	-61.731	281.259	325.049	143.815	-6.968	343.115	372.145
80.000	-90.414	-115.111	-20.631	147.820	130.393	-69.834	287.803	323.589	126.450	-10.916	360.086	382.017

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

POINT REL. LINEAR DISPLACEMENT (IN.)

TIME	POINT (0.00, 0.00, 0.00) ON SEGMENT NO. 3 - UT IN VEH REFERENCE				POINT (0.00, 0.00, 0.00) ON SEGMENT NO. 5 - H IN VEH REFERENCE				POINT (0.00, 0.00, 0.00) ON SEGMENT NO. 5 - H IN UT REFERENCE			
(MSEC)	X	Y	Z	RES	X	Y	Z	RES	X	Y	Z	RES
0.000	11.314	0.000	-26.938	29.217	7.775	0.000	-41.833	42.550	-0.022	0.000	-15.310	15.310
2.000	11.314	0.000	-26.938	29.218	7.775	0.000	-41.833	42.550	-0.022	0.000	-15.310	15.310
4.000	11.316	0.000	-26.938	29.218	7.777	0.000	-41.834	42.550	-0.022	0.000	-15.310	15.310
6.000	11.320	0.000	-26.939	29.221	7.782	0.000	-41.834	42.552	-0.023	0.000	-15.310	15.310
8.000	11.330	0.000	-26.940	29.225	7.791	0.000	-41.835	42.554	-0.023	0.000	-15.310	15.310
10.000	11.345	0.000	-26.941	29.232	7.806	0.000	-41.836	42.558	-0.022	0.000	-15.310	15.310
12.000	11.368	0.000	-26.943	29.243	7.828	0.000	-41.838	42.564	-0.022	0.000	-15.310	15.310
14.000	11.400	0.000	-26.945	29.257	7.860	0.000	-41.840	42.572	-0.021	0.000	-15.310	15.310
16.000	11.442	0.000	-26.949	29.277	7.901	0.000	-41.844	42.583	-0.020	0.001	-15.310	15.310
18.000	11.496	-0.001	-26.953	29.302	7.954	0.000	-41.848	42.597	-0.017	0.001	-15.310	15.310
20.000	11.564	-0.001	-26.958	29.334	8.021	0.000	-41.853	42.614	-0.015	0.001	-15.310	15.310
22.000	11.646	-0.001	-26.965	29.372	8.102	0.000	-41.859	42.636	-0.011	0.002	-15.310	15.310
24.000	11.745	-0.002	-26.972	29.419	8.199	0.000	-41.866	42.661	-0.005	0.004	-15.310	15.310
26.000	11.861	-0.002	-26.982	29.474	8.314	-0.001	-41.876	42.693	0.003	0.008	-15.310	15.310
28.000	11.996	-0.003	-26.994	29.539	8.447	-0.002	-41.887	42.730	0.014	0.016	-15.310	15.310
30.000	12.152	-0.003	-27.007	29.615	8.601	-0.003	-41.899	42.773	0.027	0.024	-15.310	15.310
32.000	12.330	-0.001	-27.021	29.701	8.777	-0.003	-41.913	42.822	0.044	0.032	-15.310	15.310
34.000	12.529	-0.001	-27.036	29.798	8.977	-0.004	-41.928	42.878	0.069	0.042	-15.310	15.310
36.000	12.750	-0.001	-27.050	29.905	9.200	-0.006	-41.943	42.940	0.102	0.056	-15.309	15.309
38.000	12.995	-0.003	-27.065	30.023	9.450	-0.008	-41.958	43.009	0.147	0.081	-15.308	15.309
40.000	13.262	-0.005	-27.079	30.152	9.726	-0.012	-41.973	43.085	0.206	0.112	-15.306	15.308
42.000	13.551	-0.007	-27.092	30.292	10.030	-0.016	-41.988	43.169	0.279	0.149	-15.303	15.306
44.000	13.857	-0.007	-27.104	30.441	10.360	-0.021	-42.002	43.261	0.371	0.191	-15.298	15.303
46.000	14.171	-0.011	-27.110	30.590	10.712	-0.027	-42.012	43.356	0.499	0.245	-15.288	15.298
48.000	14.486	-0.019	-27.107	30.735	11.086	-0.035	-42.014	43.452	0.659	0.307	-15.273	15.290
50.000	14.784	-0.037	-27.087	30.859	11.478	-0.046	-42.001	43.541	0.868	0.380	-15.247	15.276
52.000	15.048	-0.075	-27.039	30.944	11.884	-0.062	-41.958	43.609	1.144	0.470	-15.201	15.252
54.000	15.266	-0.138	-26.953	30.976	12.302	-0.083	-41.873	43.643	1.487	0.561	-15.128	15.212
56.000	15.424	-0.230	-26.821	30.940	12.727	-0.111	-41.726	43.624	1.930	0.645	-15.010	15.148
58.000	15.520	-0.349	-26.641	30.834	13.156	-0.149	-41.507	43.543	2.449	0.714	-14.836	15.054
60.000	15.493	-0.507	-26.412	30.624	13.579	-0.197	-41.214	43.394	2.991	0.751	-14.606	14.928
62.000	15.381	-0.699	-26.130	30.319	13.993	-0.253	-40.832	43.164	3.548	0.697	-14.323	14.772
64.000	15.193	-0.909	-25.837	29.987	14.395	-0.318	-40.382	42.872	4.108	0.585	-13.976	14.579
66.000	15.017	-1.126	-25.554	29.661	14.790	-0.390	-39.887	42.543	4.633	0.439	-13.570	14.354
68.000	14.848	-1.347	-25.302	29.368	15.180	-0.466	-39.371	42.199	5.107	0.285	-13.141	14.101
70.000	14.693	-1.569	-25.096	29.123	15.563	-0.549	-38.845	41.851	5.526	0.131	-12.660	13.815
72.000	14.552	-1.795	-24.938	28.929	15.938	-0.639	-38.313	41.500	5.887	-0.018	-12.144	13.496
74.000	14.417	-2.024	-24.824	28.779	16.297	-0.737	-37.772	41.145	6.179	-0.156	-11.604	13.147
76.000	14.275	-2.255	-24.759	28.668	16.641	-0.842	-37.225	40.784	6.409	-0.281	-11.038	12.767
78.000	14.118	-2.487	-24.742	28.595	16.959	-0.959	-36.667	40.411	6.577	-0.392	-10.451	12.355
80.000	13.944	-2.719	-24.786	28.551	17.242	-1.090	-36.098	40.019	6.684	-0.491	-9.851	11.915

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD
VEHICLE DECELERATION: SLED ACCELERATION - 200 PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

SEGMENT ANGULAR ACCELERATION (REV/SEC.**2)

TIME	SEGMENT NO. 3 - UT IN UT REFERENCE				SEGMENT NO. 5 - H IN H REFERENCE				SEGMENT NO. 5 - H IN VEH REFERENCE			
(MSEC)	X	Y	Z	RES	X	Y	Z	RES	X	Y	Z	RES
0.000	0.000	-0.137	0.000	0.137	0.000	-0.185	0.000	0.185	0.000	-0.185	0.000	0.185
2.000	0.001	-0.042	0.002	0.043	-0.001	-0.052	0.000	0.052	-0.001	-0.052	0.000	0.052
4.000	0.008	0.040	0.015	0.043	-0.006	-0.067	0.000	0.067	-0.006	-0.067	0.002	0.067
6.000	-0.004	0.247	0.049	0.252	0.021	-0.177	-0.001	0.178	0.020	-0.177	-0.005	0.178
8.000	-0.039	0.665	0.129	0.678	0.107	-0.365	-0.002	0.380	0.104	-0.365	-0.027	0.380
10.000	-0.080	1.188	0.277	1.223	0.221	-0.482	0.002	0.530	0.215	-0.482	-0.050	0.530
12.000	-0.118	1.611	0.416	1.669	0.332	-0.284	0.018	0.424	0.328	-0.284	-0.082	0.424
14.000	-0.083	1.943	0.457	1.997	0.283	-0.730	0.029	0.784	0.282	-0.730	-0.038	0.784
16.000	-0.087	2.460	0.635	2.542	0.302	-1.430	0.043	1.462	0.303	-1.430	-0.029	1.462
18.000	0.008	2.589	0.664	2.673	0.141	-1.610	0.060	1.617	0.151	-1.610	0.028	1.617
20.000	0.037	2.973	0.948	3.120	0.102	-2.115	0.080	2.119	0.118	-2.115	0.054	2.119
22.000	-0.010	3.607	1.429	3.879	0.244	-3.094	0.108	3.106	0.262	-3.094	0.048	3.106
24.000	-8.800	7.157	4.790	12.171	7.768	-7.307	0.183	10.666	7.598	-7.307	-1.828	10.668
26.000	-9.914	7.450	4.950	13.353	10.014	-8.144	0.309	12.911	9.812	-8.143	-2.022	12.911
28.000	-1.602	6.837	5.335	8.819	0.731	-7.928	0.450	7.974	0.814	-7.928	0.280	7.974
30.000	-2.418	7.045	5.092	9.022	-1.971	-8.546	0.594	8.791	-1.785	-8.548	1.017	8.791
32.000	-5.518	18.568	11.214	22.381	8.491	-29.792	0.788	30.988	8.434	-29.793	-1.243	30.988
34.000	-5.789	14.342	10.997	18.977	8.985	-28.116	1.107	29.537	8.988	-28.117	-1.045	29.537
36.000	-10.236	20.115	12.679	25.887	15.101	-38.011	1.455	40.927	15.018	-38.013	-2.127	40.927
38.000	-27.100	28.891	17.134	41.848	30.178	-51.830	1.903	60.008	29.808	-51.828	-5.111	60.008
40.000	-22.699	24.663	16.092	37.182	22.068	-57.722	2.414	61.843	21.998	-57.727	-2.878	61.843
42.000	-30.498	28.252	24.219	48.113	21.827	-71.925	2.986	75.223	21.854	-71.937	-2.442	75.223
44.000	-32.187	56.105	49.690	81.565	50.733	-136.186	3.903	145.381	50.213	-136.179	-8.335	145.381
46.000	-28.042	37.572	48.859	67.714	44.055	-148.830	5.035	155.391	44.064	-148.865	-5.761	158.391
48.000	-20.702	-4.036	40.577	45.731	24.155	-149.938	7.474	152.055	24.678	-150.038	-0.423	152.055
50.000	-48.385	37.032	81.432	101.704	138.703	-302.280	11.208	333.190	138.788	-302.255	-10.874	333.190
52.000	20.899	8.412	77.489	80.698	86.870	-320.679	15.481	332.598	87.017	-320.899	-8.573	332.598
54.000	21.075	54.615	169.909	178.711	120.265	-438.481	21.646	455.190	120.241	-438.852	-12.223	455.190
56.000	15.799	22.276	164.884	167.130	113.182	-428.843	29.299	444.494	113.279	-429.795	-4.359	444.494
58.000	-70.850	-73.615	-213.885	237.035	205.076	-427.000	38.749	475.117	204.444	-428.884	3.808	475.117
60.000	213.357	-282.895	320.674	477.894	-54.947	-388.330	39.469	392.208	-56.394	-388.083	-6.237	392.208
62.000	88.426	-23.362	27.240	95.430	-20.082	-300.005	42.503	303.879	[illegible]	-302.770	1.119	303.879
64.000	44.445	-34.608	-63.285	84.723	-20.168	-163.484	40.806	169.676	-26.390	-167.272	10.865	169.676
66.000	-14.123	-63.981	-141.182	155.845	35.355	-125.898	37.342	135.906	24.584	-131.014	28.957	135.906
68.000	-37.438	-24.558	-71.335	84.222	82.975	-179.967	38.180	201.450	87.795	-180.059	36.984	201.450
70.000	-38.031	-65.178	-38.947	84.920	90.968	-166.521	37.777	193.473	88.935	-174.339	47.809	193.473
72.000	-58.153	-115.779	-40.978	135.889	65.468	-78.947	39.363	108.427	34.892	-88.935	54.800	108.427
74.000	-73.956	-128.701	-33.634	152.206	71.790	-104.065	35.913	131.427	39.042	-114.114	52.218	131.427
76.000	-108.913	-153.734	-12.238	188.802	85.877	-134.273	35.927	163.386	48.823	-145.580	57.501	163.386
78.000	-133.289	-152.796	3.154	202.787	80.966	-120.334	37.667	149.849	34.375	-133.462	58.820	149.849
80.000	-132.606	-117.860	3.936	177.457	51.234	-55.966	40.143	85.842	-0.345	-70.727	48.845	85.842

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD
VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

SEGMENT REL. ANGULAR VELOCITY (REV/SEC.)

TIME	SEGMENT NO. 3 - UT IN VEH REFERENCE				SEGMENT NO. 5 - H IN VEH REFERENCE				SEGMENT NO. 5 - H IN H REFERENCE			
(MSEC)	X	Y	Z	RES	X	Y	Z	RES	X	Y	Z	RES
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.001	0.000	-0.001	0.000	0.001
8.000	0.000	0.001	0.000	0.001	0.000	-0.001	0.000	0.001	0.000	-0.001	0.000	0.001
10.000	0.000	0.003	0.001	0.003	0.001	-0.002	0.000	0.002	0.001	-0.002	0.000	0.002
12.000	0.000	0.006	0.002	0.006	0.001	-0.003	0.000	0.003	0.001	-0.003	0.000	0.003
14.000	0.000	0.009	0.003	0.010	0.002	-0.004	0.000	0.004	0.002	-0.004	0.000	0.004
16.000	0.000	0.011	0.004	0.014	0.002	-0.006	0.000	0.006	0.002	-0.006	0.000	0.006
18.000	0.000	0.018	0.005	0.019	0.003	-0.009	0.000	0.009	0.003	-0.009	0.000	0.009
20.000	0.000	0.024	0.006	0.025	0.004	-0.013	0.000	0.013	0.004	-0.013	0.000	0.013
22.000	0.001	0.031	0.009	0.032	0.005	-0.018	-0.001	0.019	0.005	-0.018	0.001	0.019
24.000	-0.012	0.044	0.021	0.050	0.016	-0.031	-0.003	0.035	0.017	-0.031	0.001	0.035
26.000	-0.026	0.058	0.033	0.072	0.033	-0.048	-0.007	0.057	0.034	-0.048	0.001	0.057
28.000	-0.036	0.072	0.048	0.093	0.048	-0.062	-0.009	0.077	0.047	-0.062	0.002	0.077
30.000	-0.038	0.085	0.055	0.108	0.044	-0.078	-0.007	0.089	0.044	-0.078	0.003	0.089
32.000	-0.037	0.112	0.075	0.139	0.045	-0.114	-0.006	0.123	0.045	-0.114	0.004	0.123
34.000	-0.048	0.146	0.102	0.185	0.067	-0.174	-0.010	0.187	0.067	-0.174	0.006	0.187
36.000	-0.076	0.180	0.132	0.236	0.105	-0.236	-0.018	0.258	0.106	-0.236	0.009	0.258
38.000	-0.114	0.231	0.174	0.311	0.158	-0.331	-0.025	0.367	0.159	-0.331	0.012	0.367
40.000	-0.139	0.277	0.212	0.376	0.200	-0.438	-0.031	0.481	0.202	-0.436	0.017	0.481
42.000	-0.172	0.328	0.260	0.452	0.239	-0.565	-0.035	0.614	0.240	-0.565	0.022	0.614
44.000	-0.198	0.409	0.348	0.571	0.285	-0.766	-0.041	0.818	0.287	-0.766	0.029	0.818
46.000	-0.235	0.504	0.489	0.728	0.385	-1.056	-0.056	1.125	0.388	-1.056	0.038	1.125
48.000	-0.229	0.530	0.567	0.809	0.447	-1.355	-0.080	1.428	0.449	-1.355	0.051	1.428
50.000	-0.241	0.669	0.811	1.079	0.652	-1.933	-0.092	2.042	0.655	-1.933	0.069	2.042
52.000	-0.192	0.728	0.893	1.246	0.850	-2.558	-0.118	2.698	0.854	-2.558	0.096	2.698
54.000	-0.059	0.902	1.343	1.618	1.071	-3.411	-0.144	3.578	1.075	-3.411	0.132	3.578
56.000	0.073	1.021	1.706	1.989	1.296	-4.299	-0.161	4.493	1.300	-4.297	0.183	4.493
58.000	0.050	0.985	1.756	2.014	1.581	-5.149	-0.162	5.389	1.586	-5.144	0.249	5.389
60.000	0.638	0.350	2.155	2.274	1.585	-6.117	-0.170	6.321	1.591	-6.109	0.325	6.321
62.000	0.889	0.383	2.284	2.480	1.553	-6.884	-0.166	7.040	1.563	-6.852	0.408	7.040
64.000	0.999	0.342	2.217	2.456	1.491	-7.290	-0.171	7.443	1.512	-7.271	0.492	7.443
66.000	0.984	0.240	2.039	2.276	1.477	-7.552	-0.134	7.696	1.514	-7.524	0.570	7.696
68.000	0.901	0.147	1.885	2.095	1.563	-7.860	-0.072	8.014	1.628	-7.821	0.642	8.014
70.000	0.823	0.060	1.817	1.996	1.708	-8.236	0.012	8.412	1.807	-8.184	0.718	8.412
72.000	0.766	-0.148	1.772	1.936	1.824	-8.520	0.116	8.722	1.975	-8.458	0.794	8.722
74.000	0.692	-0.414	1.729	1.906	1.879	-8.677	0.222	8.881	2.095	-8.586	0.868	8.881
76.000	0.606	-0.733	1.717	1.963	1.971	-8.960	0.328	9.180	2.256	-8.849	0.939	9.180
78.000	0.491	-1.104	1.763	2.136	2.058	-9.256	0.445	9.492	2.428	-9.120	1.013	9.492
80.000	0.353	-1.429	1.829	2.347	2.089	-9.448	0.553	9.692	2.557	-9.285	1.090	9.692

DATE: 2 SEPT 1988

RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

PAGE: 26.01

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK

CRASH VICTIM: 95TH PERCENTILE MALE

SEGMENT REL. ANGULAR DISPLACEMENT (DEG)

TIME	SEGMENT NO. 3 - UT IN VEH REFERENCE				SEGMENT NO. 5 - H IN VEH REFERENCE				SEGMENT NO. 5 - H IN UT REFERENCE			
(MSEC)	YAW	PITCH	ROLL	RES	YAW	PITCH	ROLL	RES	YAW	PITCH	ROLL	RES
0.000	0.000	13.280	0.000	13.280	0.000	13.460	0.000	13.460	0.000	0.180	0.000	0.180
2.000	0.000	13.280	0.000	13.280	0.000	13.460	0.000	13.460	0.000	0.180	0.000	0.180
4.000	0.000	13.280	0.000	13.280	0.000	13.460	0.000	13.460	0.000	0.180	0.000	0.180
6.000	0.000	13.280	0.000	13.280	0.000	13.459	0.000	13.459	0.000	0.180	0.000	0.180
8.000	0.000	13.280	0.000	13.280	0.000	13.459	0.000	13.459	0.000	0.179	0.000	0.179
10.000	0.001	13.281	0.000	13.281	0.000	13.458	0.000	13.458	-0.001	0.178	0.000	0.178
12.000	0.001	13.284	0.000	13.284	0.000	13.456	0.001	13.456	-0.001	0.171	0.001	0.172
14.000	0.003	13.290	0.000	13.290	0.000	13.454	0.002	13.454	-0.003	0.164	0.003	0.164
16.000	0.005	13.298	0.000	13.298	0.000	13.450	0.003	13.450	-0.005	0.152	0.005	0.152
18.000	0.008	13.310	0.000	13.310	0.000	13.445	0.005	13.445	-0.008	0.135	0.007	0.136
20.000	0.012	13.325	0.000	13.325	0.000	13.437	0.008	13.437	-0.011	0.112	0.010	0.113
22.000	0.018	13.345	0.001	13.345	0.001	13.426	0.011	13.426	-0.016	0.081	0.014	0.084
24.000	0.027	13.372	-0.003	13.372	0.001	13.409	0.018	13.409	-0.025	0.037	0.027	0.052
26.000	0.043	13.409	-0.017	13.409	0.002	13.381	0.036	13.382	-0.040	-0.027	0.063	0.079
28.000	0.067	13.456	-0.042	13.456	0.003	13.343	0.067	13.343	-0.062	-0.115	0.124	0.179
30.000	0.097	13.513	-0.069	13.513	0.005	13.293	0.101	13.293	-0.088	-0.220	0.191	0.305
32.000	0.136	13.582	-0.095	13.583	0.008	13.227	0.132	13.228	-0.126	-0.354	0.257	0.455
34.000	0.193	13.675	-0.127	13.677	0.011	13.123	0.173	13.124	-0.178	-0.552	0.343	0.673
36.000	0.265	13.791	-0.175	13.795	0.017	12.978	0.237	12.980	-0.245	-0.813	0.471	0.970
38.000	0.359	13.939	-0.243	13.946	0.023	12.775	0.333	12.779	-0.332	-1.169	0.657	1.374
40.000	0.478	14.123	-0.336	14.136	0.032	12.500	0.466	12.508	-0.443	-1.620	0.916	1.907
42.000	0.617	14.341	-0.449	14.364	0.042	12.140	0.626	12.156	-0.578	-2.196	1.220	2.572
44.000	0.797	14.601	-0.582	14.638	0.055	11.672	0.813	11.700	-0.757	-2.920	1.563	3.398
46.000	1.052	14.935	-0.739	14.997	0.068	11.017	1.061	11.067	-1.018	-3.903	2.055	4.511
48.000	1.383	15.315	-0.905	15.414	0.082	10.140	1.367	10.240	-1.367	-5.141	2.620	5.902
50.000	1.837	15.754	-1.063	15.912	0.093	8.975	1.755	9.144	-1.860	-6.738	3.301	7.683
52.000	2.445	16.263	-1.213	16.515	0.095	7.361	2.304	7.712	-2.548	-8.837	4.197	10.024
54.000	3.282	16.853	-1.270	17.247	0.077	5.221	2.994	6.017	-3.499	-11.531	5.240	12.994
56.000	4.376	17.548	-1.225	18.167	0.024	2.443	3.846	4.556	-4.836	-14.854	6.468	16.740
58.000	5.730	18.282	-1.076	19.232	-0.080	-0.956	4.867	4.960	-6.520	-19.021	7.925	21.188
60.000	7.196	18.725	-0.798	20.112	-0.263	-5.032	6.043	7.858	-8.457	-23.473	9.510	26.030
62.000	9.010	18.894	-0.167	20.927	-0.545	-9.713	7.216	12.079	-10.799	-28.287	10.903	31.183
64.000	10.887	19.035	0.596	21.863	-0.927	-14.611	8.405	16.864	-13.329	-33.526	12.297	36.700
66.000	12.684	19.097	1.389	22.806	-1.407	-20.134	9.632	22.235	-15.925	-38.944	13.770	42.339
68.000	14.326	19.070	2.120	23.692	-2.012	-25.641	10.994	27.755	-18.620	-44.470	15.523	48.056
70.000	15.868	18.985	2.772	24.554	-2.808	-31.383	12.610	33.588	-21.668	-50.163	17.827	53.960
72.000	17.346	18.800	3.344	25.369	-3.876	-37.343	14.579	39.712	-25.358	-55.941	20.842	60.003
74.000	18.753	18.447	3.806	26.080	-5.305	-43.404	16.970	46.004	-30.054	-61.584	25.198	66.009
76.000	20.091	17.906	4.127	26.679	-7.292	-49.559	19.970	52.473	-36.534	-66.989	31.360	71.966
78.000	21.384	17.148	4.271	27.175	-10.213	-55.825	23.994	59.178	-46.425	-71.980	41.030	77.911
80.000	22.660	16.168	4.207	27.614	-14.704	-62.089	29.648	66.073	-62.537	-76.081	56.973	83.815

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD
PAGE: 27.01
VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

JOINT PARAMETERS

	JOINT NO. 3 - HP							JOINT NO. 4 - HP						
TIME	STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN. LB.)			STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN. LB.)		
(MSEC)	IPIN	FLEXURE	AZIMUTH	TORSION	SPRING	VISCOUS	RES.	IPIN	FLEXURE	AZIMUTH	TORSION	SPRING	VISCOUS	RES.
0.000	0.	10.180	0.000	0.000	0.000	0.000	0.000	0.	10.000	0.000	0.000	0.000	0.000	0.000
2.000	0.	10.181	0.000	0.000	0.000	0.118	0.118	0.	9.999	0.000	0.000	0.000	0.118	0.118
4.000	0.	10.184	0.000	0.000	0.000	0.190	0.190	0.	9.996	0.000	0.000	0.000	0.194	0.194
6.000	0.	10.189	0.000	0.000	0.000	0.241	0.241	0.	9.991	0.000	0.000	0.000	0.263	0.263
8.000	0.	10.194	-0.001	0.000	0.000	0.224	0.224	0.	9.985	0.001	0.000	0.000	0.303	0.303
10.000	0.	10.197	-0.005	0.000	0.000	0.115	0.115	0.	9.979	0.002	0.000	0.000	0.284	0.284
12.000	0.	10.197	-0.013	-0.001	0.000	0.168	0.168	0.	9.974	0.005	0.000	0.000	0.187	0.187
14.000	0.	10.192	-0.026	-0.002	0.000	0.401	0.401	0.	9.971	0.009	-0.001	0.000	0.112	0.112
16.000	0.	10.182	-0.042	-0.003	0.000	0.680	0.680	0.	9.970	0.012	-0.002	0.000	0.069	0.069
18.000	0.	10.166	-0.061	-0.004	0.000	0.977	0.977	0.	9.969	0.013	-0.003	0.000	0.072	0.072
20.000	0.	10.144	-0.081	-0.006	0.000	1.281	1.281	0.	9.968	0.012	-0.004	0.000	0.104	0.104
22.000	0.	10.115	-0.104	-0.009	0.000	1.728	1.728	0.	9.967	0.009	-0.006	0.000	0.122	0.122
24.000	0.	10.068	-0.222	-0.013	0.000	3.586	3.586	0.	9.970	0.048	-0.009	0.000	0.771	0.771
26.000	0.	9.997	-0.530	-0.019	0.000	5.256	5.256	0.	9.977	0.134	-0.016	0.000	0.081	0.081
28.000	0.	9.907	-0.984	-0.026	0.000	6.009	6.009	0.	9.981	0.211	-0.024	0.000	0.458	0.458
30.000	0.	9.805	-1.332	-0.039	0.000	6.012	6.012	0.	9.978	0.136	-0.034	0.000	1.331	1.331
32.000	0.	9.671	-1.592	-0.058	0.000	9.857	9.857	0.	9.978	-0.039	-0.045	0.000	1.704	1.704
34.000	0.	9.440	-2.129	-0.084	0.000	14.463	14.463	0.	10.014	-0.105	-0.062	0.000	2.267	2.267
36.000	0.	9.152	-3.083	-0.113	0.000	18.782	18.782	0.	10.046	-0.075	-0.088	0.000	2.371	2.371
38.000	0.	8.767	-4.576	-0.147	0.000	26.352	26.352	0.	10.095	-0.005	-0.122	0.000	3.606	3.606
40.000	0.	8.280	-6.692	-0.188	0.000	31.362	31.362	0.	10.149	0.007	-0.163	0.000	3.348	3.348
42.000	0.	7.699	-9.366	-0.240	0.000	37.757	37.757	0.	10.187	-0.171	-0.212	0.000	4.202	4.202
44.000	0.	6.972	-12.870	-0.317	0.000	52.652	52.652	0.	10.265	-0.573	-0.268	0.000	7.887	7.887
46.000	0.	5.966	-19.595	-0.430	0.000	71.325	71.325	0.	10.445	-0.726	-0.352	0.000	11.132	11.132
48.000	0.	4.869	-30.850	-0.581	0.000	80.360	80.360	0.	10.827	-1.080	-0.464	0.000	10.999	10.999
50.000	0.	3.822	-54.577	-0.804	0.000	125.388	125.388	0.	10.957	-1.213	-0.617	0.000	25.143	25.143
52.000	0.	4.001	-95.947	-1.088	0.000	150.487	150.487	0.	11.421	-0.891	-0.839	0.000	25.934	25.934
54.000	0.	8.124	-127.683	-1.502	0.000	193.882	193.882	0.	11.949	-0.784	-1.122	0.000	32.818	32.818
56.000	0.	9.668	-143.883	-2.084	0.000	220.529	220.529	0.	12.423	-0.721	-1.497	0.000	27.056	27.056
58.000	0.	13.878	-152.083	-2.748	0.000	235.094	235.094	0.	12.563	-0.690	-1.964	0.000	26.095	26.095
60.000	0.	18.379	-157.625	-3.482	0.000	234.042	234.042	0.	12.544	-1.090	-2.448	0.000	28.518	28.518
62.000	0.	22.709	-162.883	-4.505	0.000	238.449	238.449	0.	12.127	-2.354	-2.954	0.000	43.769	43.769
64.000	0.	26.899	-167.023	-5.484	18.036	216.552	233.247	0.	11.096	-3.358	-3.457	0.000	73.428	73.428
66.000	0.	30.558	-170.082	-6.297	154.456	176.484	324.873	0.	9.293	-4.188	-3.894	0.000	115.796	115.796
68.000	0.	33.331	-172.228	-6.882	347.082	123.565	462.542	0.	6.430	-6.114	-4.250	0.000	175.281	175.281
70.000	0.	35.027	-173.783	-7.296	502.714	67.615	559.233	0.	2.361	-10.607	-4.534	0.000	244.357	244.357
72.000	0.	35.552	-174.978	-7.592	493.636	30.690	494.729	0.	3.448	-162.475	-4.760	0.000	303.225	303.225
74.000	0.	35.540	-175.910	-7.807	466.062	.24.286	466.652	0.	9.415	-172.198	-4.909	0.000	300.392	300.392
76.000	0.	35.544	-176.681	-7.960	539.760	20.815	540.627	0.	15.394	-174.585	-4.988	0.000	299.780	299.780
78.000	0.	35.568	-177.364	-8.079	558.450	19.211	561.920	0.	21.358	-175.662	-5.027	0.000	295.975	295.975
80.000	0.	35.764	-178.027	-8.198	579.271	26.658	596.493	0.	27.109	-176.275	-5.046	22.243	278.893	300.921

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD
VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

RP JOINT FORCES & TORQUES ON R IN R REFERENCE

TIME	JOINT FORCE (LB. 10**2)			JOINT TORQUE (IN.- LB. 10**2)		
(MSEC)	X	Y	Z	X	Y	Z
0.000	0.000	0.000	-0.126	0.000D+00	0.000D+00	0.000D+00
2.000	0.000	0.000	-0.129	-0.119D-06	0.118D-02	0.232D-07
4.000	0.001	0.000	-0.136	-0.839D-07	0.184D-02	0.765D-06
6.000	0.002	0.000	-0.142	0.273D-04	0.263D-02	0.587D-05
8.000	0.002	0.000	-0.148	0.116D-03	0.303D-02	0.258D-04
10.000	0.001	-0.001	-0.156	0.238D-03	0.283D-02	0.725D-04
12.000	-0.001	-0.001	-0.171	0.365D-03	0.163D-02	0.160D-03
14.000	-0.003	-0.001	-0.181	0.383D-03	0.101D-02	0.284D-03
16.000	-0.005	-0.001	-0.190	0.287D-03	0.458D-03	0.427D-03
18.000	-0.005	0.000	-0.202	0.148D-03	0.370D-03	0.601D-03
20.000	-0.007	0.000	-0.210	0.503D-05	0.665D-03	0.800D-03
22.000	-0.010	-0.001	-0.218	0.670D-04	0.574D-03	0.107D-02
24.000	-0.024	-0.021	-0.273	0.675D-02	-0.325D-02	0.181D-02
26.000	-0.027	-0.028	-0.270	0.883D-02	-0.301D-02	0.305D-02
28.000	-0.026	-0.002	-0.254	0.106D-02	-0.444D-03	0.444D-02
30.000	-0.029	0.004	-0.263	-0.115D-01	0.330D-02	0.586D-02
32.000	-0.097	-0.027	-0.164	-0.105D-01	-0.109D-01	0.776D-02
34.000	-0.090	-0.026	-0.153	-0.180D-02	-0.198D-01	0.108D-01
36.000	-0.123	-0.043	-0.131	0.560D-02	-0.182D-01	0.141D-01
38.000	-0.167	-0.086	-0.217	0.121D-01	-0.287D-01	0.182D-01
40.000	-0.187	-0.065	-0.200	-0.436D-02	-0.242D-01	0.227D-01
42.000	-0.235	-0.067	-0.280	-0.207D-01	-0.239D-01	0.277D-01
44.000	-0.440	-0.151	0.231	-0.200D-01	-0.675D-01	0.356D-01
46.000	-0.476	-0.133	0.180	-0.666D-02	-0.902D-01	0.600D-01
48.000	-0.484	-0.078	0.423	-0.409D-01	-0.785D-01	0.653D-01
50.000	-0.964	-0.400	1.929	0.475D-01	-0.229D+00	0.927D-01
52.000	-1.025	-0.250	2.650	0.333D-01	-0.227D+00	0.122D+00
54.000	-1.406	-0.348	4.626	0.417D-01	-0.281D+00	0.181D+00
56.000	-1.393	-0.331	5.514	0.379D-01	-0.168D+00	0.208D+00
58.000	-1.416	-0.595	5.141	0.810D-01	0.106D-01	0.244D+00
60.000	-1.296	0.123	7.496	-0.979D-01	0.101D+00	0.248D+00
62.000	-1.049	0.016	5.739	-0.807D-01	0.339D+00	0.284D+00
64.000	-0.656	0.016	3.853	-0.406D-01	0.692D+00	0.241D+00
66.000	-0.806	-0.153	1.823	-0.400D-01	0.114D+01	0.202D+00
68.000	-0.887	-0.314	1.048	-0.123D+00	0.174D+01	0.171D+00
70.000	-0.958	-0.369	1.210	-0.259D+00	0.242D+01	0.156D+00
72.000	-0.758	-0.324	1.329	-0.380D+00	0.300D+01	0.143D+00
74.000	-0.842	-0.344	1.491	-0.344D+00	0.298D+01	0.897D-01
76.000	-0.939	-0.393	2.383	-0.340D+00	0.298D+01	0.605D-01
78.000	-0.884	-0.387	3.033	-0.337D+00	0.294D+01	0.453D-01
80.000	-0.676	-0.312	3.738	-0.352D+00	0.299D+01	0.461D-01

DATE: 2 SEPT 1988 PAGE 34
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD PAGE: 29.01
VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

BODY PROPERTIES - REFERENCE SEGMENT NO. 16 (VEH)

INCLUDED SEGMENT NOS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

TIME	CENTER OF GRAVITY (IN.)			LINEAR MOMENTUM (LB.-SEC.)			ANGULAR MOMENTUM (IN.- LB.-SEC.)			KINETIC ENERGY (LB.- IN.)		
(MSEC)	X	Y	Z	X	Y	Z	X	Y	Z	LINEAR	ANGULAR	TOTAL
0.000	18.183	0.000	-20.231	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00	0.000D+00
2.000	18.183	0.000	-20.231	-0.252D-01	0.287D-06	0.723D-04	-0.699D-04	0.197D-01	0.304D-03	0.382D-01	0.495D-02	0.431D-01
4.000	18.185	0.000	-20.231	-0.121D+00	-0.220D-04	-0.665D-02	-0.641D-03	0.993D+00	0.158D-02	0.505D+00	0.344D-01	0.539D+00
6.000	18.189	0.000	-20.231	-0.299D+00	-0.442D-03	-0.326D-01	-0.121D-01	0.341D+01	0.154D-02	0.242D+01	0.137D+00	0.256D+01
8.000	18.197	0.000	-20.231	-0.543D+00	-0.201D-02	-0.842D-01	-0.554D-01	0.730D+01	-0.472D-02	0.754D+01	0.391D+00	0.793D+01
10.000	18.210	0.000	-20.232	-0.841D+00	-0.497D-02	-0.187D+00	-0.138D+00	0.127D+02	-0.181D-01	0.184D+02	0.862D+00	0.192D+02
12.000	18.230	0.000	-20.233	-0.118D+01	-0.991D-02	-0.283D+00	-0.275D+00	0.194D+02	-0.448D-01	0.384D+02	0.155D+01	0.399D+02
14.000	18.257	0.000	-20.234	-0.155D+01	-0.150D-01	-0.435D+00	-0.416D+00	0.274D+02	-0.749D-01	0.717D+02	0.247D+01	0.742D+02
16.000	18.294	0.000	-20.236	-0.195D+01	-0.197D-01	-0.622D+00	-0.546D+00	0.366D+02	-0.985D-01	0.123D+03	0.365D+01	0.127D+03
18.000	18.342	0.000	-20.239	-0.239D+01	-0.243D-01	-0.844D+00	-0.671D+00	0.469D+02	-0.121D+00	0.200D+03	0.515D+01	0.205D+03
20 000	18.402	0.000	-20.242	-0.287D+01	-0.286D-01	-0.110D+01	-0.789D+00	0.584D+02	-0.134D+00	0.307D+03	0.698D+01	0.314D+03
22.000	18.476	0.000	-20.247	-0.340D+01	-0.356D-01	-0.140D+01	-0.982D+00	0.713D+02	-0.157D+00	0.451D+03	0.923D+01	0.461D+03
24.000	18.564	-0.001	-20.253	-0.401D+01	-0.350D-01	-0.183D+01	-0.164D+01	0.880D+02	0.204D+00	0.641D+03	0.118D+02	0.653D+03
26.000	18.669	-0.001	-20.260	-0.463D+01	-0.365D-01	-0.227D+01	-0.252D+01	0.105D+03	0.607D+00	0.886D+03	0.146D+02	0.901D+03
28.000	18.792	-0.001	-20.270	-0.528D+01	-0.204D-02	-0.270D+01	-0.226D+01	0.122D+03	0.141D+01	0.120D+04	0.179D+02	0.122D+04
30.000	18.933	-0.001	-20.280	-0.598D+01	0.973D-01	-0.311D+01	0.483D+00	0.139D+03	0.286D+01	0.158D+04	0.216D+02	0.160D+04
32.000	19.095	0.000	-20.292	-0.691D+01	0.132D+00	-0.341D+01	0.168D+01	0.160D+03	0.401D+01	0.204D+04	0.264D+02	0.206D+04
34.000	19.278	0.000	-20.306	-0.820D+01	0.583D-01	-0.369D+01	-0.240D+00	0.189D+03	0.455D+01	0.256D+04	0.343D+02	0.259D+04
36.000	19.481	0.000	-20.320	-0.988D+01	0.265D-01	-0.410D+01	-0.155D+01	0.226D+03	0.628D+01	0.315D+04	0.483D+02	0.320D+04
38.000	19.704	0.001	-20.336	-0.122D+02	0.801D-01	-0.454D+01	-0.166D+01	0.277D+03	0.101D+02	0.379D+04	0.731D+02	0.386D+04
40.000	19.948	0.001	-20.354	-0.149D+02	0.324D+00	-0.494D+01	0.272D+01	0.333D+03	0.171D+02	0.449D+04	0.104D+03	0.460D+04
42.000	20.212	0.003	-20.373	-0.180D+02	0.787D+00	-0.541D+01	0.108D+02	0.400D+03	0.278D+02	0.520D+04	0.136D+03	0.533D+04
44.000	20.492	0.007	-20.393	-0.220D+02	0.103D+01	-0.537D+01	0.138D+02	0.483D+03	0.377D+02	0.576D+04	0.166D+03	0.593D+04
46.000	20.782	0.010	-20.412	-0.272D+02	0.825D+00	-0.462D+01	0.200D+01	0.583D+03	0.427D+02	0.611D+04	0.192D+03	0.631D+04
48.000	21.078	0.014	-20.426	-0.336D+02	0.103D+01	-0.313D+01	-0.118D+01	0.699D+03	0.516D+02	0.623D+04	0.206D+03	0.644D+04
50.000	21.369	0.015	-20.431	-0.431D+02	-0.477D+00	0.120D+01	-0.558D+02	0.860D+03	0.409D+02	0.588D+04	0.251D+03	0.614D+04
52.000	21.644	0.010	-20.418	-0.545D+02	-0.246D+01	0.687D+01	-0.122D+03	0.104D+04	0.198D+02	0.539D+04	0.363D+03	0.575D+04
54.000	21.894	-0.005	-20.377	-0.685D+02	-0.545D+01	0.145D+02	-0.211D+03	0.126D+04	-0.927D+01	0.491D+04	0.673D+03	0.558D+04
56.000	22.111	-0.030	-20.309	-0.834D+02	-0.852D+01	0.220D+02	-0.295D+03	0.161D+04	-0.346D+02	0.471D+04	0.104D+04	0.574D+04
58.000	22.290	-0.069	-20.216	-0.991D+02	-0.135D+02	0.279D+02	-0.411D+03	0.179D+04	-0.797D+02	0.476D+04	0.128D+04	0.604D+04
60.000	22.406	-0.126	-20.096	-0.125D+03	-0.182D+02	0.375D+02	-0.524D+03	0.227D+04	-0.120D+03	0.581D+04	0.201D+04	0.782D+04
62.000	22.463	-0.202	-19.952	-0.140D+03	-0.221D+02	0.392D+02	-0.608D+03	0.259D+04	-0.146D+03	0.655D+04	0.226D+04	0.881D+04
64.000	22.487	-0.287	-19.810	-0.150D+03	-0.237D+02	0.370D+02	-0.647D+03	0.284D+04	-0.148D+03	0.673D+04	0.223D+04	0.896D+04
66.000	22.490	-0.376	-19.683	-0.158D+03	-0.241D+02	0.311D+02	-0.659D+03	0.306D+04	-0.145D+03	0.640D+04	0.206D+04	0.846D+04
68.000	22.476	-0.465	-19.584	-0.166D+03	-0.239D+02	0.220D+02	-0.658D+03	0.329D+04	-0.144D+03	0.579D+04	0.189D+04	0.768D+04
70.000	22.446	-0.552	-19.523	-0.171D+03	-0.235D+02	0.114D+02	-0.651D+03	0.348D+04	-0.141D+03	0.524D+04	0.177D+04	0.700D+04
72.000	22.406	-0.640	-19.495	-0.175D+03	-0.237D+02	0.416D+01	-0.648D+03	0.360D+04	-0.142D+03	0.464D+04	0.164D+04	0.648D+04
74.000	22.358	-0.728	-19.490	-0.180D+03	-0.238D+02	-0.130D+01	-0.646D+03	0.369D+04	-0.147D+03	0.453D+04	0.150D+04	0.604D+04
76.000	22.298	-0.816	-19.505	-0.183D+03	-0.240D+02	-0.635D+01	-0.648D+03	0.377D+04	-0.156D+03	0.443D+04	0.143D+04	0.587D+04
78.000	22.233	-0.905	-19.537	-0.185D+03	-0.242D+02	-0.114D+02	-0.655D+03	0.383D+04	-0.166D+03	0.456D+04	0.146D+04	0.602D+04
80.000	22.165	-0.995	-19.588	-0.186D+03	-0.244D+02	-0.161D+02	-0.650D+03	0.386D+04	-0.176D+03	0.477D+04	0.155D+04	0.632D+04

DATE: 2 SEPT 1988

RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE
CONTACT FORCES - SEGMENT PANELS VS. SEGMENTS

	PANEL 1 (SEAT, 6 DEGREE OFF H) VS. SEGMENT 1 (LT)							PANEL 1 (SEAT, 6 DEGREE OFF H) VS. SEGMENT 6 (RUL)						
TIME (MSEC)	DEFL-ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) (VEH REFERENCE) X	Y	Z	DEFL-ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) (VEH REFERENCE) X	Y	Z
0.000	0.458	137.10	0.00	137.10	14.372	0.000	-10.459	0.250	29.94	0.00	29.94	24.725	3.420	-11.545
2.000	0.458	137.02	8.94	137.31	14.373	0.000	-10.459	0.250	31.22	4.99	31.62	24.725	3.420	-11.545
4.000	0.458	136.86	27.51	139.60	14.375	0.000	-10.459	0.250	36.09	15.37	39.70	24.726	3.420	-11.545
6.000	0.458	136.72	46.60	144.44	14.380	0.000	-10.460	0.250	44.22	22.11	49.44	24.727	3.420	-11.545
8.000	0.457	138.78	64.83	153.18	14.390	0.000	-10.461	0.251	51.70	25.85	57.80	24.729	3.420	-11.546
10.000	0.458	144.58	72.29	161.65	14.407	0.000	-10.462	0.251	58.35	29.18	65.24	24.732	3.420	-11.546
12.000	0.458	152.48	76.24	170.48	14.431	0.000	-10.465	0.252	63.83	31.91	71.36	24.737	3.420	-11.546
14.000	0.458	161.71	80.85	180.80	14.464	0.000	-10.468	0.253	68.37	34.18	76.44	24.744	3.420	-11.547
16.000	0.459	172.39	86.19	192.73	14.508	0.000	-10.473	0.254	72.13	36.06	80.64	24.755	3.420	-11.548
18.000	0.459	184.02	92.01	205.74	14.565	-0.001	-10.479	0.255	75.12	37.56	83.99	24.770	3.420	-11.550
20.000	0.460	196.74	98.37	219.96	14.635	-0.001	-10.486	0.256	76.24	38.12	85.24	24.790	3.420	-11.552
22.000	0.461	211.45	105.72	236.41	14.720	-0.001	-10.495	0.257	74.47	37.23	83.26	24.816	3.420	-11.555
24.000	0.463	200.50	100.25	224.17	14.822	-0.001	-10.506	0.257	66.45	33.22	74.29	24.849	3.420	-11.558
26.000	0.464	199.45	99.72	222.99	14.942	-0.001	-10.519	0.257	58.64	29.32	65.56	24.891	3.420	-11.563
28.000	0.465	207.89	103.94	232.42	15.081	0.000	-10.533	0.256	49.90	24.95	55.79	24.942	3.420	-11.568
30.000	0.466	228.27	114.13	255.21	15.242	0.001	-10.550	0.255	45.48	22.74	50.85	25.002	3.420	-11.574
32.000	0.468	279.53	139.76	312.52	15.424	0.006	-10.569	0.253	53.74	26.87	60.08	25.069	3.421	-11.581
34.000	0.472	356.68	178.34	398.78	15.630	0.018	-10.591	0.251	53.97	26.99	60.35	25.138	3.421	-11.589
36.000	0.478	448.62	224.31	501.57	15.859	0.038	-10.615	0.248	38.40	19.20	42.93	25.207	3.421	-11.596
38.000	0.485	560.72	280.36	626.90	16.111	0.079	-10.641	0.244	37.83	18.91	42.29	25.272	3.422	-11.603
40.000	0.496	634.27	317.14	709.14	16.385	0.146	-10.670	0.239	65.17	32.59	72.87	25.324	3.424	-11.608
42.000	0.510	664.96	332.48	743.44	16.679	0.237	-10.701	0.234	89.40	44.70	99.96	25.364	3.428	-11.612
44.000	0.527	703.41	351.70	786.43	16.985	0.346	-10.733	0.230	119.38	59.69	133.47	25.391	3.434	-11.615
46.000	0.551	756.42	378.21	845.71	17.293	0.460	-10.765	0.227	157.62	78.81	176.23	25.402	3.441	-11.616
48.000	0.585	828.62	414.31	926.43	17.592	0.567	-10.797	0.225	201.14	100.57	224.88	25.394	3.451	-11.615
50.000	0.634	922.91	461.45	1031.84	17.867	0.638	-10.826	0.226	230.71	115.35	257.94	25.366	3.464	-11.613
52.000	0.705	1043.08	521.54	1166.20	18.102	0.630	-10.850	0.225	229.76	114.88	256.88	25.326	3.480	-11.606
54.000	0.806	1090.42	545.21	1219.13	18.285	0.526	-10.869	0.227	275.31	137.65	307.80	25.267	3.497	-11.602
56.000	0.942	1085.51	542.75	1213.64	18.410	0.360	-10.883	0.237	287.36	143.68	321.28	25.149	3.514	-11.590
58.000	1.113	1255.01	627.50	1403.14	18.483	0.194	-10.890	0.263	319.10	159.55	356.77	24.927	3.526	-11.567
60.000	1.323	1450.74	725.37	1621.98	18.497	0.037	-10.892	0.312	369.55	184.78	413.17	24.569	3.528	-11.531
62.000	1.576	1827.33	913.67	2043.02	18.468	-0.132	-10.889	0.373	440.16	220.08	492.11	24.222	3.511	-11.493
64.000	1.825	2293.38	1146.69	2564.07	18.450	-0.237	-10.887	0.443	571.56	285.78	639.04	23.850	3.487	-11.453
66.000	2.046	2723.02	1361.51	3044.43	18.439	-0.287	-10.886	0.512	745.66	372.83	833.68	23.509	3.460	-11.418
68.000	2.217	3434.09	1717.05	3839.43	18.418	-0.298	-10.883	0.565	895.38	447.69	1001.07	23.230	3.435	-11.388
70.000	2.318	3801.87	1900.93	4250.62	18.370	-0.288	-10.878	0.584	304.97	152.49	340.97	23.046	3.419	-11.369
72.000	2.356	2969.04	1484.52	3319.48	18.300	-0.277	-10.871	0.585	279.61	139.80	312.61	22.958	3.408	-11.360
74.000	2.342	2947.61	1473.80	3295.52	18.218	-0.271	-10.862	0.515	213.84	106.92	239.08	22.945	3.400	-11.359
76.000	2.282	2851.26	210.71	2859.04	18.125	-0.274	-10.853	0.436	108.38	54.19	121.18	23.013	3.395	-11.366
78.000	2.180	2688.19	119.57	2690.85	18.036	-0.292	-10.843	0.328	45.56	22.78	50.93	23.161	3.390	-11.381
80.000	2.039	2461.74	235.32	2472.96	17.954	-0.332	-10.835	0.191	18.66	9.33	20.86	23.244	3.381	-11.390

DATE: 2 SEPT 1988

RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

PAGE: 31.01

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK

CRASH VICTIM: 95TH PERCENTILE MALE

CONTACT FORCES - SEGMENT PANELS VS. SEGMENTS

	PANEL 1 (SEAT, 6 DEGREE OFF H) VS. SEGMENT 9 (LUL)							PANEL 2 (BACK PANEL, 13 DEGR) VS. SEGMENT 1 (LT)						
TIME (MSEC)	DEFL-ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) (VEH REFERENCE) X	Y	Z	DEFL-ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) (VEH REFERENCE) X	Y	Z
0.000	0.250	29.94	0.00	29.94	24.725	-3.420	-11.545	0.055	2.77	0.00	2.77	9.382	0.000	-12.874
2.000	0.250	31.23	5.00	31.62	24.725	-3.420	-11.545	0.055	2.76	0.40	2.79	9.382	0.000	-12.874
4.000	0.250	36.71	15.41	39.81	24.726	-3.420	-11.545	0.054	2.68	0.97	2.85	9.382	0.000	-12.875
6.000	0.250	44.24	22.12	49.46	24.727	-3.420	-11.545	0.050	2.51	1.25	2.80	9.382	0.000	-12.876
8.000	0.251	51.74	25.87	57.84	24.729	-3.420	-11.546	0.044	2.18	1.09	2.44	9.382	0.000	-12.877
10.000	0.251	58.41	29.21	65.30	24.732	-3.420	-11.546	0.033	1.65	0.83	1.85	9.381	0.000	-12.880
12.000	0.252	63.91	31.95	71.45	24.737	-3.420	-11.546	0.017	0.86	0.43	0.96	9.380	0.000	-12.884
14.000	0.253	68.45	34.23	76.53	24.744	-3.420	-11.547	-0.006	0.00	0.00	0.00	0.000	0.000	0.000
16.000	0.254	72.21	36.10	80.73	24.755	-3.420	-11.548	-0.036	0.00	0.00	0.00	0.000	0.000	0.000
18.000	0.255	75.19	37.60	84.07	24.770	-3.420	-11.550	-0.077	0.00	0.00	0.00	0.000	0.000	0.000
20.000	0.256	76.31	38.16	85.32	24.790	-3.420	-11.552	-0.128	0.00	0.00	0.00	0.000	0.000	0.000
22.000	0.257	74.63	37.31	83.43	24.815	-3.420	-11.555	-0.192	0.00	0.00	0.00	0.000	0.000	0.000
24.000	0.257	65.18	32.59	72.87	24.849	-3.420	-11.558	-0.269	0.00	0.00	0.00	0.000	0.000	0.000
26.000	0.257	56.40	28.20	63.06	24.891	-3.420	-11.563	-0.362	0.00	0.00	0.00	0.000	0.000	0.000
28.000	0.256	47.59	23.79	53.20	24.943	-3.420	-11.568	-0.472	0.00	0.00	0.00	0.000	0.000	0.000
30.000	0.254	34.68	17.34	38.78	25.005	-3.420	-11.575	-0.601	0.00	0.00	0.00	0.000	0.000	0.000
32.000	0.252	30.42	15.21	34.01	25.079	-3.419	-11.582	-0.749	0.00	0.00	0.00	0.000	0.000	0.000
34.000	0.248	29.66	14.83	33.16	25.166	-3.419	-11.592	-0.918	0.00	0.00	0.00	0.000	0.000	0.000
36.000	0.241	28.14	14.07	31.46	25.280	-3.419	-11.604	-1.108	0.00	0.00	0.00	0.000	0.000	0.000
38.000	0.227	25.44	12.72	28.44	25.426	-3.418	-11.619	-1.317	0.00	0.00	0.00	0.000	0.000	0.000
40.000	0.206	21.30	10.65	23.81	25.615	-3.415	-11.639	-1.546	0.00	0.00	0.00	0.000	0.000	0.000
42.000	0.179	16.89	8.45	18.89	25.850	-3.411	-11.663	-1.794	0.00	0.00	0.00	0.000	0.000	0.000
44.000	0.147	12.03	6.01	13.45	26.130	-3.405	-11.693	-2.056	0.00	0.00	0.00	0.000	0.000	0.000
46.000	0.112	6.87	3.43	7.68	26.435	-3.396	-11.725	-2.328	0.00	0.00	0.00	0.000	0.000	0.000
48.000	0.080	3.99	1.99	4.46	26.760	-3.386	-11.759	-2.601	0.00	0.00	0.00	0.000	0.000	0.000
50.000	0.056	2.78	1.39	3.11	27.008	-3.372	-11.785	-2.864	0.00	0.00	0.00	0.000	0.000	0.000
52.000	0.051	58.93	29.46	65.88	27.020	-3.355	-11.786	-3.104	0.00	0.00	0.00	0.000	0.000	0.000
54.000	0.076	84.08	42.04	94.01	26.648	-3.335	-11.747	-3.311	0.00	0.00	0.00	0.000	0.000	0.000
56.000	0.137	138.11	69.06	154.41	26.015	-3.313	-11.681	-3.479	0.00	0.00	0.00	0.000	0.000	0.000
58.000	0.228	165.60	82.80	185.14	25.312	-3.292	-11.607	-3.609	0.00	0.00	0.00	0.000	0.000	0.000
60.000	0.353	148.11	74.06	165.60	24.605	-3.280	-11.533	-3.695	0.00	0.00	0.00	0.000	0.000	0.000
62.000	0.522	357.14	178.57	399.30	23.920	-3.280	-11.461	-3.747	0.00	0.00	0.00	0.000	0.000	0.000
64.000	0.684	686.47	343.24	767.50	23.448	-3.290	-11.411	-3.784	0.00	0.00	0.00	0.000	0.000	0.000
66.000	0.819	1246.33	623.16	1393.44	23.155	-3.301	-11.380	-3.811	0.00	0.00	0.00	0.000	0.000	0.000
68.000	0.905	1699.87	849.94	1900.52	22.994	-3.313	-11.364	-3.828	0.00	0.00	0.00	0.000	0.000	0.000
70.000	0.924	758.55	379.27	848.08	22.932	-3.322	-11.357	-3.837	0.00	0.00	0.00	0.000	0.000	0.000
72.000	0.888	710.46	355.23	794.31	22.936	-3.329	-11.358	-3.838	0.00	0.00	0.00	0.000	0.000	0.000
74.000	0.814	611.98	305.99	684.21	22.992	-3.333	-11.363	-3.831	0.00	0.00	0.00	0.000	0.000	0.000
76.000	0.713	477.86	238.93	534.26	23.096	-3.334	-11.374	-3.811	0.00	0.00	0.00	0.000	0.000	0.000
78.000	0.591	314.21	157.11	351.30	23.266	-3.333	-11.392	-3.793	0.00	0.00	0.00	0.000	0.000	0.000
80.000	0.450	126.56	63.28	141.50	23.529	-3.333	-11.420	-3.782	0.00	0.00	0.00	0.000	0.000	0.000

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

PAGE: 32.01

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE
CONTACT FORCES - SEGMENT PANELS VS. SEGMENTS

TIME (MSEC)	PANEL 2 (BACK PANEL. 13 DEGR) VS. SEGMENT 2 (CT): DEFL- ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) (VEH REFERENCE) X	Y	Z	PANEL 2 (BACK PANEL. 13 DEGR) VS. SEGMENT 3 (UT): DEFL- ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) (VEH REFERENCE) X	Y	Z
0.000	-0.312	0.00	0.00	0.00	0.000	0.000	0.000	0.133	9.90	0.00	9.90	6.151	0.000	-26.665
2.000	-0.312	0.00	0.00	0.00	0.000	0.000	0.000	0.132	9.87	0.06	9.87	6.151	0.000	-26.665
4.000	-0.314	0.00	0.00	0.00	0.000	0.000	0.000	0.131	9.61	0.75	9.64	6.151	0.000	-26.665
6.000	-0.320	0.00	0.00	0.00	0.000	0.000	0.000	0.128	8.90	1.74	9.07	6.151	0.000	-26.664
8.000	-0.330	0.00	0.00	0.00	0.000	0.000	0.000	0.117	7.52	2.55	7.94	6.152	0.000	-26.663
10.000	-0.347	0.00	0.00	0.00	0.000	0.000	0.000	0.102	5.25	2.42	5.77	6.152	0.000	-26.661
12.000	-0.372	0.00	0.00	0.00	0.000	0.000	0.000	0.079	3.95	1.98	4.42	6.153	0.000	-26.658
14.000	-0.406	0.00	0.00	0.00	0.000	0.000	0.000	0.048	2.38	1.19	2.66	6.154	0.000	-26.654
16.000	-0.452	0.00	0.00	0.00	0.000	0.000	0.000	0.006	0.30	0.15	0.33	6.155	0.000	-26.649
18.000	-0.510	0.00	0.00	0.00	0.000	0.000	0.000	-0.048	0.00	0.00	0.00	0.000	0.000	0.000
20.000	-0.583	0.00	0.00	0.00	0.000	0.000	0.000	-0.114	0.00	0.00	0.00	0.000	0.000	0.000
22.000	-0.671	0.00	0.00	0.00	0.000	0.000	0.000	-0.196	0.00	0.00	0.00	0.000	0.000	0.000
24.000	-0.778	0.00	0.00	0.00	0.000	0.000	0.000	-0.294	0.00	0.00	0.00	0.000	0.000	0.000
26.000	-0.901	0.00	0.00	0.00	0.000	0.000	0.000	-0.409	0.00	0.00	0.00	0.000	0.000	0.000
28.000	-1.045	0.00	0.00	0.00	0.000	0.000	0.000	-0.542	0.00	0.00	0.00	0.000	0.000	0.000
30.000	-1.211	0.00	0.00	0.00	0.000	0.000	0.000	-0.698	0.00	0.00	0.00	0.000	0.000	0.000
32.000	-1.400	0.00	0.00	0.00	0.000	0.000	0.000	-0.872	0.00	0.00	0.00	0.000	0.000	0.000
34.000	-1.612	0.00	0.00	0.00	0.000	0.000	0.000	-1.067	0.00	0.00	0.00	0.000	0.000	0.000
36.000	-1.849	0.00	0.00	0.00	0.000	0.000	0.000	-1.284	0.00	0.00	0.00	0.000	0.000	0.000
38.000	-2.110	0.00	0.00	0.00	0.000	0.000	0.000	-1.523	0.00	0.00	0.00	0.000	0.000	0.000
40.000	-2.397	0.00	0.00	0.00	0.000	0.000	0.000	-1.783	0.00	0.00	0.00	0.000	0.000	0.000
42.000	-2.707	0.00	0.00	0.00	0.000	0.000	0.000	-2.064	0.00	0.00	0.00	0.000	0.000	0.000
44.000	-3.034	0.00	0.00	0.00	0.000	0.000	0.000	-2.361	0.00	0.00	0.00	0.000	0.000	0.000
46.000	-3.370	0.00	0.00	0.00	0.000	0.000	0.000	-2.662	0.00	0.00	0.00	0.000	0.000	0.000
48.000	-3.702	0.00	0.00	0.00	0.000	0.000	0.000	-2.960	0.00	0.00	0.00	0.000	0.000	0.000
50.000	-4.012	0.00	0.00	0.00	0.000	0.000	0.000	-3.238	0.00	0.00	0.00	0.000	0.000	0.000
52.000	-4.276	0.00	0.00	0.00	0.000	0.000	0.000	-3.473	0.00	0.00	0.00	0.000	0.000	0.000
54.000	-4.477	0.00	0.00	0.00	0.000	0.000	0.000	-3.652	0.00	0.00	0.00	0.000	0.000	0.000
56.000	-4.606	0.00	0.00	0.00	0.000	0.000	0.000	-3.757	0.00	0.00	0.00	0.000	0.000	0.000
58.000	-4.661	0.00	0.00	0.00	0.000	0.000	0.000	-3.787	0.00	0.00	0.00	0.000	0.000	0.000
60.000	-4.582	0.00	0.00	0.00	0.000	0.000	0.000	-3.689	0.00	0.00	0.00	0.000	0.000	0.000
62.000	-4.378	0.00	0.00	0.00	0.000	0.000	0.000	-3.478	0.00	0.00	0.00	0.000	0.000	0.000
64.000	-4.149	0.00	0.00	0.00	0.000	0.000	0.000	-3.225	0.00	0.00	0.00	0.000	0.000	0.000
66.000	-3.915	0.00	0.00	0.00	0.000	0.000	0.000	-2.965	0.00	0.00	0.00	0.000	0.000	0.000
68.000	-3.689	0.00	0.00	0.00	0.000	0.000	0.000	-2.720	0.00	0.00	0.00	0.000	0.000	0.000
70.000	-3.476	0.00	0.00	0.00	0.000	0.000	0.000	-2.499	0.00	0.00	0.00	0.000	0.000	0.000
72.000	-3.281	0.00	0.00	0.00	0.000	0.000	0.000	-2.303	0.00	0.00	0.00	0.000	0.000	0.000
74.000	-3.098	0.00	0.00	0.00	0.000	0.000	0.000	-2.127	0.00	0.00	0.00	0.000	0.000	0.000
76.000	-2.921	0.00	0.00	0.00	0.000	0.000	0.000	-1.960	0.00	0.00	0.00	0.000	0.000	0.000
78.000	-2.744	0.00	0.00	0.00	0.000	0.000	0.000	-1.791	0.00	0.00	0.00	0.000	0.000	0.000
80.000	-2.561	0.00	0.00	0.00	0.000	0.000	0.000	-1.618	0.00	0.00	0.00	0.000	0.000	0.000

DATE: 2 SEPT 1988

RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION

TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

PAGE: 33.01

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK

CRASH VICTIM: 95TH PERCENTILE MALE

CONTACT FORCES - SEGMENT PANELS VS. SEGMENTS

	PANEL 3 (FLOOR.) VS. SEGMENT 8 (RF)							PANEL 3 (FLOOR.) VS. SEGMENT 11 (LF)						
TIME (MSEC)	DEFL-ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) (VEH REFERENCE) X	Y	Z	DEFL-ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) (VEH REFERENCE) X	Y	Z
0.000	0.096	4.82	0.00	4.82	46.596	3.420	-1.300	0.096	4.82	0.00	4.82	46.596	-3.420	-1.300
2.000	0.097	4.88	0.97	4.98	46.596	3.420	-1.300	0.097	4.88	0.97	4.98	46.596	-3.420	-1.300
4.000	0.097	4.97	2.11	5.40	46.597	3.420	-1.300	0.097	4.98	2.11	5.40	46.597	-3.420	-1.300
6.000	0.097	5.05	2.52	5.64	46.601	3.420	-1.300	0.097	5.05	2.52	5.64	46.601	-3.420	-1.300
8.000	0.098	5.02	2.51	5.62	46.609	3.420	-1.300	0.098	5.03	2.52	5.62	46.609	-3.420	-1.300
10.000	0.098	4.90	2.45	5.48	46.620	3.420	-1.300	0.098	4.91	2.46	5.49	46.620	-3.420	-1.300
12.000	0.098	4.88	2.44	5.46	46.638	3.420	-1.300	0.098	4.89	2.44	5.46	46.638	-3.420	-1.300
14.000	0.097	4.83	2.42	5.41	46.662	3.420	-1.300	0.097	4.84	2.42	5.41	46.662	-3.420	-1.300
16.000	0.095	4.75	2.37	5.31	46.693	3.420	-1.300	0.095	4.76	2.38	5.32	46.694	-3.420	-1.300
18.000	0.092	4.61	2.31	5.16	46.734	3.420	-1.300	0.093	4.63	2.31	5.17	46.734	-3.420	-1.300
20.000	0.088	4.42	2.21	4.94	46.784	3.420	-1.300	0.089	4.44	2.22	4.97	46.784	-3.420	-1.300
22.000	0.083	4.17	2.08	4.66	46.844	3.420	-1.300	0.084	4.19	2.10	4.69	46.845	-3.420	-1.300
24.000	0.077	3.85	1.92	4.30	46.915	3.420	-1.300	0.078	3.88	1.94	4.34	46.916	-3.420	-1.300
26.000	0.069	3.46	1.73	3.86	46.998	3.420	-1.300	0.070	3.50	1.75	3.91	46.999	-3.420	-1.300
28.000	0.060	2.99	1.50	3.35	47.092	3.420	-1.300	0.061	3.05	1.52	3.41	47.093	-3.420	-1.300
30.000	0.049	2.46	1.23	2.75	47.199	3.420	-1.300	0.051	2.54	1.27	2.83	47.201	-3.420	-1.300
32.000	0.037	1.85	0.93	2.07	47.318	3.420	-1.300	0.040	1.98	0.99	2.21	47.322	-3.420	-1.300
34.000	0.022	1.12	0.56	1.26	47.448	3.420	-1.300	0.027	1.36	0.68	1.52	47.456	-3.420	-1.300
36.000	0.004	0.19	0.10	0.21	47.583	3.420	-1.300	0.013	0.65	0.32	0.73	47.597	-3.420	-1.300
38.000	-0.021	0.00	0.00	0.00	0.000	0.000	0.000	-0.004	0.00	0.00	0.00	0.000	0.000	0.000
40.000	-0.052	0.00	0.00	0.00	0.000	0.000	0.000	-0.024	0.00	0.00	0.00	0.000	0.000	0.000
42.000	-0.092	0.00	0.00	0.00	0.000	0.000	0.000	-0.047	0.00	0.00	0.00	0.000	0.000	0.000
44.000	-0.140	0.00	0.00	0.00	0.000	0.000	0.000	-0.072	0.00	0.00	0.00	0.000	0.000	0.000
46.000	-0.199	0.00	0.00	0.00	0.000	0.000	0.000	-0.101	0.00	0.00	0.00	0.000	0.000	0.000
48.000	-0.266	0.00	0.00	0.00	0.000	0.000	0.000	-0.137	0.00	0.00	0.00	0.000	0.000	0.000
50.000	-0.348	0.00	0.00	0.00	0.000	0.000	0.000	-0.183	0.00	0.00	0.00	0.000	0.000	0.000
52.000	-0.440	0.00	0.00	0.00	0.000	0.000	0.000	-0.245	0.00	0.00	0.00	0.000	0.000	0.000
54.000	-0.543	0.00	0.00	0.00	0.000	0.000	0.000	-0.330	0.00	0.00	0.00	0.000	0.000	0.000
56.000	-0.661	0.00	0.00	0.00	0.000	0.000	0.000	-0.434	0.00	0.00	0.00	0.000	0.000	0.000
58.000	-0.798	0.00	0.00	0.00	0.000	0.000	0.000	-0.554	0.00	0.00	0.00	0.000	0.000	0.000
60.000	-0.960	0.00	0.00	0.00	0.000	0.000	0.000	-0.686	0.00	0.00	0.00	0.000	0.000	0.000
62.000	-1.145	0.00	0.00	0.00	0.000	0.000	0.000	-0.830	0.00	0.00	0.00	0.000	0.000	0.000
64.000	-1.351	0.00	0.00	0.00	0.000	0.000	0.000	-0.974	0.00	0.00	0.00	0.000	0.000	0.000
66.000	-1.576	0.00	0.00	0.00	0.000	0.000	0.000	-1.122	0.00	0.00	0.00	0.000	0.000	0.000
68.000	-1.817	0.00	0.00	0.00	0.000	0.000	0.000	-1.277	0.00	0.00	0.00	0.000	0.000	0.000
70.000	-2.071	0.00	0.00	0.00	0.000	0.000	0.000	-1.448	0.00	0.00	0.00	0.000	0.000	0.000
72.000	-2.335	0.00	0.00	0.00	0.000	0.000	0.000	-1.625	0.00	0.00	0.00	0.000	0.000	0.000
74.000	-2.606	0.00	0.00	0.00	0.000	0.000	0.000	-1.812	0.00	0.00	0.00	0.000	0.000	0.000
76.000	-2.883	0.00	0.00	0.00	0.000	0.000	0.000	-2.005	0.00	0.00	0.00	0.000	0.000	0.000
78.000	-3.160	0.00	0.00	0.00	0.000	0.000	0.000	-2.199	0.00	0.00	0.00	0.000	0.000	0.000
80.000	-3.434	0.00	0.00	0.00	0.000	0.000	0.000	-2.387	0.00	0.00	0.00	0.000	0.000	0.000

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE
CONTACT FORCES - SEGMENT PANELS VS. SEGMENTS

	PANEL 4 (HEAD PAD. 13 DEGR) VS. SEGMENT 5 (H)							PANEL 10 (RUDDER PEDALS.) VS. SEGMENT 8 (RF)						
	DEFL-	NORMAL	FRICTION	RESULTANT	CONTACT LOCATION (IN.)			DEFL-	NORMAL	FRICTION	RESULTANT	CONTACT LOCATION (IN.)		
TIME	ECTION	FORCE	FORCE	FORCE	(VEH REFERENCE)			ECTION	FORCE	FORCE	FORCE	(VEH REFERENCE)		
(MSEC)	(IN.)	(LB.)	(LB.)	(LB.)	X	Y	Z	(IN.)	(LB.)	(LB.)	(LB.)	X	Y	Z
0.000	0.050	2.48	0.00	2.48	3.035	0.000	-40.978	0.002	0.00	0.00	0.00	51.239	3.420	-3.286
2.000	0.049	2.47	0.02	2.47	3.035	0.000	-40.978	0.001	0.07	0.01	0.07	51.239	3.420	-3.286
4.000	0.046	2.38	0.19	2.39	3.035	0.000	-40.978	0.002	0.11	0.04	0.12	51.239	3.420	-3.285
6.000	0.043	2.15	0.41	2.19	3.035	0.000	-40.977	0.005	0.29	0.14	0.32	51.240	3.420	-3.287
8.000	0.034	1.70	0.55	1.78	3.035	0.000	-40.976	0.010	0.75	0.37	0.83	51.245	3.420	-3.291
10.000	0.019	0.85	0.41	1.03	3.038	0.000	-40.974	0.019	1.59	0.80	1.78	51.254	3.420	-3.298
12.000	-0.003	0.00	0.00	0.00	0.000	0.000	0.000	0.031	2.66	1.33	2.98	51.266	3.420	-3.309
14.000	-0.034	0.00	0.00	0.00	0.000	0.000	0.000	0.048	4.09	2.05	4.58	51.284	3.420	-3.323
16.000	-0.075	0.00	0.00	0.00	0.000	0.000	0.000	0.070	5.92	2.96	6.62	51.306	3.420	-3.342
18.000	-0.128	0.00	0.00	0.00	0.000	0.000	0.000	0.096	8.17	4.08	9.13	51.334	3.420	-3.365
20.000	-0.194	0.00	0.00	0.00	0.000	0.000	0.000	0.128	13.66	6.83	15.28	51.367	3.420	-3.393
22.000	-0.274	0.00	0.00	0.00	0.000	0.000	0.000	0.165	20.41	10.21	22.82	51.406	3.420	-3.426
24.000	-0.371	0.00	0.00	0.00	0.000	0.000	0.000	0.205	28.17	14.09	31.50	51.464	3.420	-3.474
26.000	-0.484	0.00	0.00	0.00	0.000	0.000	0.000	0.249	38.47	19.24	43.01	51.490	3.420	-3.490
28.000	-0.617	0.00	0.00	0.00	0.000	0.000	0.000	0.296	49.29	24.64	55.10	51.503	3.420	-3.507
30.000	-0.770	0.00	0.00	0.00	0.000	0.000	0.000	0.343	60.44	30.22	67.58	51.511	3.420	-3.514
32.000	-0.945	0.00	0.00	0.00	0.000	0.000	0.000	0.392	71.83	35.92	80.31	51.516	3.420	-3.518
34.000	-1.142	0.00	0.00	0.00	0.000	0.000	0.000	0.440	128.19	64.09	143.32	51.520	3.420	-3.521
36.000	-1.363	0.00	0.00	0.00	0.000	0.000	0.000	0.477	178.75	89.37	199.85	51.521	3.420	-3.522
38.000	-1.610	0.00	0.00	0.00	0.000	0.000	0.000	0.490	204.92	102.46	229.11	51.519	3.420	-3.521
40.000	-1.882	0.00	0.00	0.00	0.000	0.000	0.000	0.498	191.03	95.51	213.58	51.515	3.420	-3.517
42.000	-2.181	0.00	0.00	0.00	0.000	0.000	0.000	0.492	182.60	91.30	204.15	51.508	3.419	-3.511
44.000	-2.505	0.00	0.00	0.00	0.000	0.000	0.000	0.482	168.82	84.41	188.75	51.501	3.418	-3.505
46.000	-2.849	0.00	0.00	0.00	0.000	0.000	0.000	0.470	153.91	76.96	172.08	51.494	3.417	-3.499
48.000	-3.211	0.00	0.00	0.00	0.000	0.000	0.000	0.460	139.82	69.91	156.32	51.489	3.415	-3.495
50.000	-3.584	0.00	0.00	0.00	0.000	0.000	0.000	0.450	126.65	63.33	141.60	51.488	3.413	-3.495
52.000	-3.960	0.00	0.00	0.00	0.000	0.000	0.000	0.441	114.28	57.14	127.77	51.494	3.410	-3.499
54.000	-4.328	0.00	0.00	0.00	0.000	0.000	0.000	0.430	100.59	50.30	112.47	51.507	3.408	-3.510
56.000	-4.675	0.00	0.00	0.00	0.000	0.000	0.000	0.415	79.36	39.68	88.73	51.531	3.402	-3.531
58.000	-4.989	0.00	0.00	0.00	0.000	0.000	0.000	0.388	57.60	28.80	64.40	51.577	3.398	-3.569
60.000	-5.254	0.00	0.00	0.00	0.000	0.000	0.000	0.346	49.17	24.59	54.98	51.679	3.394	-3.654
62.000	-5.458	0.00	0.00	0.00	0.000	0.000	0.000	0.289	37.73	18.86	42.18	51.812	3.392	-3.767
64.000	-5.609	0.00	0.00	0.00	0.000	0.000	0.000	0.215	23.04	11.52	25.75	51.976	3.393	-3.904
66.000	-5.724	0.00	0.00	0.00	0.000	0.000	0.000	0.125	8.82	4.41	9.86	52.183	3.400	-4.077
68.000	-5.817	0.00	0.00	0.00	0.000	0.000	0.000	0.020	0.99	0.49	1.10	52.440	3.417	-4.294
70.000	-5.894	0.00	0.00	0.00	0.000	0.000	0.000	-0.101	0.00	0.00	0.00	0.000	0.000	0.000
72.000	-5.963	0.00	0.00	0.00	0.000	0.000	0.000	-0.231	0.00	0.00	0.00	0.000	0.000	0.000
74.000	-6.032	0.00	0.00	0.00	-0.000	0.000	0.000	-0.367	0.00	0.00	0.00	0.000	0.000	0.000
76.000	-6.105	0.00	0.00	0.00	0.000	0.000	0.000	-0.510	0.00	0.00	0.00	0.000	0.000	0.000
78.000	-6.178	0.00	0.00	0.00	0.000	0.000	0.000	-0.655	0.00	0.00	0.00	0.000	0.000	0.000
80.000	-6.252	0.00	0.00	0.00	0.000	0.000	0.000	-0.800	0.00	0.00	0.00	0.000	0.000	0.000

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE
CONTACT FORCES - SEGMENT PANELS VS. SEGMENTS

PANEL 10 (RUDDER PEDALS.   ) VS. SEGMENT 11 (LF)

TIME (MSEC)	DEFL-ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) (VEH REFERENCE) X	Y	Z
0.000	0.002	0.08	0.00	0.08	51.239	-3.420	-3.288
2.000	0.001	0.07	0.01	0.07	51.239	-3.420	-3.288
4.000	0.002	0.11	0.04	0.12	51.239	-3.420	-3.295
6.000	0.005	0.29	0.14	0.32	51.240	-3.420	-3.287
8.000	0.010	0.75	0.37	0.83	51.245	-3.420	-3.291
10.000	0.019	1.60	0.80	1.78	51.254	-3.420	-3.298
12.000	0.031	2.67	1.33	2.98	51.266	-3.420	-3.308
14.000	0.048	4.10	2.05	4.58	51.284	-3.420	-3.323
16.000	0.070	5.93	2.96	6.63	51.306	-3.420	-3.342
18.000	0.096	8.18	4.09	9.15	51.334	-3.420	-3.365
20.000	0.128	13.70	6.85	15.32	51.366	-3.420	-3.393
22.000	0.165	20.47	10.23	22.88	51.406	-3.420	-3.425
24.000	0.206	28.28	14.13	31.59	51.484	-3.420	-3.474
26.000	0.250	38.58	19.29	43.14	51.489	-3.420	-3.496
28.000	0.298	49.45	24.73	55.29	51.503	-3.420	-3.507
30.000	0.344	60.69	30.34	67.85	51.511	-3.420	-3.513
32.000	0.394	72.29	36.14	80.82	51.518	-3.420	-3.518
34.000	0.444	133.60	66.80	149.37	51.519	-3.420	-3.520
36.000	0.483	188.09	94.05	210.29	51.519	-3.420	-3.520
38.000	0.507	219.74	109.87	245.68	51.515	-3.420	-3.516
40.000	0.514	216.05	108.03	241.55	51.508	-3.420	-3.511
42.000	0.515	213.02	106.51	238.16	51.497	-3.421	-3.502
44.000	0.514	212.01	106.00	237.03	51.482	-3.422	-3.490
46.000	0.514	211.89	105.95	236.90	51.465	-3.423	-3.475
48.000	0.514	212.07	106.04	237.10	51.446	-3.425	-3.459
50.000	0.511	207.70	103.85	232.22	51.425	-3.427	-3.441
52.000	0.498	190.37	95.18	212.83	51.399	-3.430	-3.420
54.000	0.472	155.61	77.80	173.97	51.301	-3.432	-3.388
56.000	0.438	107.92	53.96	120.66	51.306	-3.435	-3.342
58.000	0.395	59.01	29.50	65.97	51.268	-3.437	-3.310
60.000	0.353	50.53	25.27	56.50	51.259	-3.438	-3.302
62.000	0.307	41.43	20.72	46.32	51.288	-3.438	-3.327
64.000	0.268	33.64	16.82	37.61	51.387	-3.436	-3.409
66.000	0.234	26.90	13.45	30.07	51.514	-3.432	-3.518
68.000	0.200	20.05	10.02	22.41	51.657	-3.425	-3.637
70.000	0.159	13.90	6.95	15.54	51.813	-3.413	-3.767
72.000	0.112	6.75	3.37	7.55	51.972	-3.393	-3.901
74.000	0.056	2.80	1.40	3.13	52.128	-3.366	-4.032
76.000	-0.008	0.00	0.00	0.00	0.000	0.000	0.000
78.000	-0.077	0.00	0.00	0.00	0.000	0.000	0.000
80.000	-0.141	0.00	0.00	0.00	0.000	0.000	0.000

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

HARNESS SYSTEM BELT ENDPOINT FORCES

	BELT NO. 1 OF HARNESS NO. 1				BELT NO. 2 OF HARNESS NO. 1			
	POINT NO. 1		POINT NO. 12		POINT NO. 13		POINT NO. 27	
TIME (MSEC)	STRAIN (IN./ IN.)	FORCE (LB.)	STRAIN (IN./ IN.)	FORCE (LB.)	STRAIN (IN./ IN.)	FORCE (LB.)	STRAIN (IN./ IN.)	FORCE (LB.)
0.000	0.000000	0.00	0.000000	0.00	0.000000	0.00	0.000000	0.00
2.000	0.000025	0.37	0.000017	0.25	0.000014	0.21	0.000018	0.27
4.000	0.000119	1.79	0.000065	0.98	0.000057	0.85	0.000152	2.27
6.000	0.000281	4.22	0.000150	2.25	0.000124	1.86	0.000470	7.04
8.000	0.000523	7.85	0.000276	4.15	0.000219	3.29	0.001018	15.27
10.000	0.000854	12.81	0.000438	6.57	0.000336	5.04	0.001803	27.04
12.000	0.001023	15.34	0.000481	7.21	0.000344	5.16	0.002454	36.81
14.000	0.001320	19.80	0.000515	7.72	0.000433	6.50	0.003168	47.52
16.000	0.001672	25.08	0.000551	8.27	0.000496	7.44	0.003856	57.84
18.000	0.001420	21.30	0.000400	6.00	0.000404	6.06	0.003427	51.41
20.000	0.001831	27.46	0.000484	7.26	0.000498	7.46	0.004276	64.13
22.000	0.002363	35.45	0.000617	9.26	0.000643	9.65	0.005479	82.19
24.000	0.003085	46.27	0.000877	13.15	0.000921	13.81	0.019008	285.12
26.000	0.004040	60.61	0.001215	18.22	0.001284	19.26	0.021036	315.53
28.000	0.006003	90.05	0.001724	25.85	0.001768	26.52	0.027340	410.10
30.000	0.009472	142.08	0.002256	33.83	0.002429	36.44	0.035707	564.14
32.000	0.013979	209.69	0.003249	48.73	0.004372	65.58	0.023671	355.06
34.000	0.019790	296.85	0.004754	71.30	0.008401	126.02	0.020865	312.97
36.000	0.026146	392.20	0.007124	106.86	0.018334	275.01	0.025025	375.38
38.000	0.032200	494.00	0.010831	162.46	0.030199	453.97	0.039302	636.04
40.000	0.037809	606.17	0.021023	315.35	0.040241	654.82	0.056200	1178.59
42.000	0.043063	711.27	0.038025	570.49	0.050245	863.00	0.075150	2182.96
44.000	0.048343	816.85	0.053858	1054.46	0.060539	1408.57	0.064897	1639.53
46.000	0.053827	1052.84	0.071518	1990.44	0.072248	2029.17	0.084525	2679.84
48.000	0.055271	1129.35	0.087363	2830.23	0.056456	1192.15	0.103767	3631.84
50.000	0.058800	1316.42	0.098307	3410.27	0.065766	1685.60	0.093883	3175.81
52.000	0.064710	1629.61	0.098688	3430.48	0.068526	1831.86	0.107224	3752.85
54.000	0.072120	2022.35	0.087992	2863.56	0.074577	2152.58	0.092636	3109.84
56.000	0.076068	2231.59	0.071069	1966.87	0.075155	2183.20	0.089018	2917.94
58.000	0.074497	2148.32	0.049516	840.31	0.069789	1898.82	0.084438	2675.23
60.000	0.061993	1485.61	0.026359	395.38	0.082583	2576.88	0.093363	3148.22
62.000	0.047024	790.48	0.005156	77.34	0.032040	490.80	0.086107	2763.69
64.000	0.028177	422.66	0.000000	0.00	0.024499	367.48	0.065353	1663.72
66.000	0.007038	105.57	0.000000	0.00	0.006231	93.46	0.051787	944.69
68.000	0.000000	0.00	0.000000	0.00	0.000000	0.00	0.037962	609.25
70.000	0.000000	0.00	0.000000	0.00	0.000000	0.00	0.022501	337.51
72.000	0.000000	0.00	0.000000	0.00	0.000000	0.00	0.012711	190.67
74.000	0.000000	0.00	0.000000	0.00	0.000000	0.00	0.006159	92.39
76.000	0.000000	0.00	0.000000	0.00	0.000000	0.00	0.000000	0.00
78.000	0.000000	0.00	0.000000	0.00	0.000000	0.00	0.000000	0.00
80.000	0.000000	0.00	0.000000	0.00	0.000000	0.00	0.000000	0.00

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD
VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

PAGE: 37.01

CONTACT FORCES - SEGMENT NO. 2 (CT) VS. SEGMENT NO. 13 (RLA)

	DEFL-	NORMAL	FRICTION	RESULTANT	CONTACT LOCATION (IN.)					
TIME	ECTION	FORCE	FORCE	FORCE	SEG. 2 LOCAL REFERENCE			SEG. 13 LOCAL REFERENCE		
(MSEC)	(IN.)	(LB.)	(LB.)	(LB.)	X	Y	Z	X	Y	Z
0.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
2.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
4.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
6.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
8.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
10.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
12.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
14.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
16.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
18.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
20.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
22.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
24.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
26.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
28.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
30.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
32.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
34.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
36.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
38.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
40.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
42.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
44.000	0.009	4.39	1.10	4.52	2.018	5.365	-1.749	-0.875	-0.809	-7.908
46.000	0.010	3.82	0.90	3.73	2.036	5.360	-1.739	-0.881	-0.803	-7.903
48.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
50.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
52.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
54.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
56.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
58.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
60.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
62.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
64.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
66.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
68.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
70.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
72.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
74.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
76.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
78.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
80.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

CONTACT FORCES - SEGMENT NO. 2 (CT) VS. SEGMENT NO. 15 (LLA)

TIME (MSEC)	DEFL-ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) SEG. 2 LOCAL REFERENCE X	Y	Z	SEG. 15 LOCAL REFERENCE X	Y	Z
0.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
2.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
4.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
6.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
8.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
10.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
12.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
14.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
16.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
18.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
20.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
22.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
24.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
26.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
28.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
30.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
32.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
34.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
36.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
38.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
40.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
42.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
44.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
46.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
48.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
50.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
52.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
54.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
56.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
58.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
60.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
62.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
64.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
66.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
68.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
70.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
72.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
74.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
76.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
78.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
80.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

CONTACT FORCES - SEGMENT NO. 6 (RUL) VS. SEGMENT NO. 13 (RLA)

	DEFL-	NORMAL	FRICTION	RESULTANT	CONTACT LOCATION (IN.)					
TIME	ECTION	FORCE	FORCE	FORCE	SEG. 6 LOCAL REFERENCE			SEG. 13 LOCAL REFERENCE		
(MSEC)	(IN.)	(LB.)	(LB.)	(LB.)	X	Y	Z	X	Y	Z
0.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
2.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
4.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
6.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
8.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
10.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
12.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
14.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
16.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
18.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
20.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
22.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
24.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
26.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
28.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
30.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
32.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
34.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
36.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
38.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
40.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
42.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
44.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
46.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
48.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
50.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
52.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
54.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
56.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
58.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
60.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
62.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
64.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
66.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
68.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
70.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
72.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
74.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
76.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
78.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
80.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

CONTACT FORCES - SEGMENT NO. 9 (LUL) VS. SEGMENT NO. 15 (LLA)

TIME (MSEC)	DEFL-ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) SEG. 9 LOCAL REFERENCE X	Y	Z	SEG. 15 LOCAL REFERENCE X	Y	Z
0.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
2.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
4.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
6.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
8.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
10.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
12.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
14.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
16.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
18.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
20.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
22.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
24.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
26.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
28.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
30.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
32.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
34.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
36.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
38.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
40.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
42.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
44.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
46.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
48.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
50.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
52.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
54.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
56.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
58.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
60.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
62.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
64.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
66.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
68.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
70.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
72.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
74.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
76.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
78.000	0.282	132.75	33.19	136.84	1.229	-1.148	10.441	-1.121	0.058	0.935
80.000	0.685	321.84	80.46	331.75	1.096	-1.142	10.037	-1.019	0.083	0.725

DATE: 2 SEPT 1988
RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD

VEHICLE DECELERATION: SLED ACCELERATION - 20G PEAK
CRASH VICTIM: 95TH PERCENTILE MALE

CONTACT FORCES - SEGMENT NO. 13 (RLA) VS. SEGMENT NO. 16 (VEH)

TIME (MSEC)	DEFL-ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) SEG. 13 LOCAL REFERENCE X	Y	Z	SEG. 16 LOCAL REFERENCE X	Y	Z
0.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
2.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
4.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
6.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
8.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
10.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
12.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
14.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
16.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
18.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
20.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
22.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
24.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
26.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
28.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
30.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
32.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
34.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
36.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
38.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
40.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
42.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
44.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
46.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
48.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
50.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
52.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
54.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
56.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
58.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
60.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
62.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
64.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
66.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
68.000	0.217	24.79	12.39	27.71	1.714	0.433	2.758	32.371	6.599	-23.212
70.000	0.496	193.03	96.51	215.81	1.651	0.428	3.110	32.482	6.706	-23.329
72.000	0.671	444.83	222.41	497.33	1.602	0.408	3.504	32.548	6.820	-23.401
74.000	0.627	382.71	181.36	405.53	1.587	0.388	3.859	32.512	6.921	-23.391
76.000	0.420	87.00	43.50	97.27	1.600	0.370	4.164	32.409	7.003	-23.320
78.000	0.219	23.90	11.95	26.72	1.612	0.354	4.449	32.311	7.076	-23.249
80.000	0.103	5.46	2.73	6.10	1.606	0.342	4.722	32.256	7.143	-23.206

DATE: 2 SEPT 1988 PAGE 47

RUN DESCRIPTION: EXAMPLE 1: BASIC SLED TEST SIMULATION
TWO BELT HARNESS WITH HYPERELLIPSOID FOR DASH BOARD PAGE: 42.01

VEHICLE DECELERATION: SLED ACCELERATION - 200 PEAK

CRASH VICTIM: 95TH PERCENTILE MALE

CONTACT FORCES - SEGMENT NO. 15 (LLA) VS. SEGMENT NO. 16 (VRH)

TIME (MSEC)	DEFL-ECTION (IN.)	NORMAL FORCE (LB.)	FRICTION FORCE (LB.)	RESULTANT FORCE (LB.)	CONTACT LOCATION (IN.) SEG. 15 LOCAL REFERENCE X	Y	Z	SEG. 16 LOCAL REFERENCE X	Y	Z
0.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
2.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
4.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
6.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
8.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
10.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
12.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
14.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
16.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
18.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
20.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
22.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
24.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
26.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
28.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
30.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
32.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
34.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
36.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
38.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
40.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
42.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
44.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
46.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
48.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
50.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
52.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
54.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
56.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
58.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
60.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
62.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
64.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
66.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
68.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
70.000	0.000	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
72.000	0.524	226.73	113.37	253.49	1.755	0.307	0.651	32.615	-6.119	-23.311
74.000	0.804	610.21	305.10	682.23	1.712	0.298	0.537	32.732	-6.130	-23.436
76.000	0.907	736.13	368.06	823.02	1.699	0.281	0.427	32.764	-6.147	-23.486
78.000	0.798	590.20	295.10	659.86	1.720	0.263	0.294	32.694	-6.176	-23.450
80.000	0.583	303.74	151.87	339.60	1.758	0.244	0.157	32.574	-6.224	-23.368

HIC, HSI AND CSI RESULTS

HEAD INJURY CRITERION

HIC = 192.44 TIME DURATION = 52.000 TO 65.000 MSEC
WITH HEAD RESULTANTS = 25.844 AND 23.464 G'S

AVERAGE HEAD RESULTANT FOR TIME DURATION = 48.574 G'S

HEAD SEVERITY INDEX

HSI = 245.20

MAX HEAD RESULTANT = 65.718 G'S AT 60.000 MSEC

CHEST SEVERITY INDEX

CSI = 733.64

MAX CHEST RESULTANT = 148.473 G'S AT 59.000 MSEC

ELAPSED CPU TIME = 291.45 SECONDS

SUB	CALLS	TIME	%
MAIN3D	1	155	0.53
INPUT	1	305	1.05
CHAIN	484	832	2.85
EJOINT	484	29	0.10
DINT	41	885	3.04
PDAUX	568	1112	3.82
DAUX	483	1056	3.62
SETUP1	483	766	2.63
CONTCT	483	444	1.52
PLELP	5313	2244	7.70
SEGSEG	2898	2029	6.96
HBELT	1072	4385	15.05
VISPR	483	1922	6.59
SETUP2	483	157	0.54
DAUX11	483	1562	5.36
DAUX12	483	678	2.33
DAUX22	483	370	1.27
FSMSOL	1072	3988	13.68
OUTPUT	86	707	2.43
UPDATE	85	53	0.18
RPTURB	85	3862	13.25
DZP	482	455	1.56
POSTPR	1	1149	3.94
TOTAL		29145	100.00

APPENDIX B

SLIP JOINT AND WIND FORCE EXAMPLE

This example ATB input and output is of two segments connected by a slip joint, and exposed to wind forces.

```
FEB. 4, 1988   0   0     0.0                                                      CARD A1A
EXAMPLE 2:  DYNAMIC JOINT TEST
SLIP JOINT / 600 KNOT WIND
 IN. LB.SEC.          0.0          0.0      386.088          0.0                 CARD A3
  4  20    0.002  0.0005    0.001 .000063                                         CARD A4
 1 020 2 0 0 0 0 0 0 0 0 0 0 0 0 0 016 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 1CARD A5
    2     1          95TH PERCENTILE MALE                                         CARD B1
LARM L 5.901 .3331 .3331 .0214 1.871 1.87110.269 0.000 0.000 0.000               CARD B2A
UARM U 5.542 .1743 .1743 .0259 2.122 2.122 7.497 0.000 0.000 0.000               CARD B2A
ELBW E    1    5  0.00  0.00  8.20  0.00  0.00 -5.42    1  0.00  0.00            CARD B3A
                  0.00  0.00  0.00  0.00-67.19  0.00
   .00    .00    .00    .00          .00    .00    .00    .00    .00        .00CARD B4
   0.0    0.0    30.    0.0    0.0                      0.0    0.0                 CARD B5
   .00    .00    .00    .00    .00    .00    .01    .01   .001   .001   .001  .001CARD B6
   .00    .00    .00    .00    .00    .00    .01    .01   .001    .00    .00   .00CARD B6
CONSTANT WIND VELOCITY OF 600 KNOTS
   0.0    0.0    0.012161.  0.00  0.00  0.00  0.00    -3    0.0   2.30      0CARD C2A
    2     1      3                                                                CARD C2B
     0.000      0.000      0.000      0.000      0.000      0.000      0.000  CARD C5
     0.000      0.000      0.000 12161.000      0.000      0.000      0.000  CARD C5
     2.300      0.000      0.000 12161.000      0.000      0.000      0.000  CARD C5
     4.600      0.000      0.000 12161.000      0.000      0.000      0.000  CARD C5
    1     0     0     0     0     0     0     1     0     0                       CARD D1
  1     WIND PLANE                                                                CARD D2A
        10.0         10.0         5.0                                             CARD D2B
       -10.0         10.0         5.0                                             CARD D2C
        10.0        -10.0         5.0                                             CARD D2D
  0   0   0   0   0   0   0   0   0   0   0   0   0   0   0                       CARD D7
 999                                                                              CARD E1
  1     WIND FORCE                                                                CARD E6A
      1.4000  13404.0000      14.6960           1           3                     CARD E6B
  0                                                                               CARD F1A
  0   0                                                                           CARD F3A
  0                                                                               CARD F4A
  1   1                                                                           CARD F7A
 -1   1   3   1   1   0   1 2 2                                                   CARD F7B
 -2   2   3   1   1   0   1 1 1                                                   CARD F7B
       0.0        0.0        0.0   0   0   0   0   1                              CARD G1A
   0.66000   0.00000 -18.98000       0.0        0.0        0.0                    CARD G2A
      0.00     -2.00      0.00      0.00      0.00      0.00  3   2   1  0CARD G3A
      0.00     -2.00      0.00      0.00      0.00      0.00  3   2   1  0CARD G3A
    0                                                                             CARD H1A
                                                                                  CARD H1B
    0                                                                             CARD H2A
                                                                                  CARD H2B
    3  2  1         0.0         0.0        8.20                                   CARD H3A
       1  2         0.0         0.0       -5.42                                   CARD H3B
       4  2         0.0         0.0         0.0                                   CARD H3B
    0                                                                             CARD H4
    0                                                                             CARD H5
```

```
0                                                        CARD H6
1       1                                                CARD H7
2   0   1   0   2                                        CARD H8
1   1   1                                                CARD H9
0                                                        CARD H10
                                                         CARD H11
```

DEVELOPED BY CALSPAN CORP., P.O. BOX 400, BUFFALO NY 14225
AND BY J&J TECHNOLOGIES INC., ORCHARD PARK, NY 14127

FOR THE AIR FORCE ARMSTRONG AEROSPACE MEDICAL RESEARCH
LABORATORY, WRIGHT PATTERSON AIR FORCE BASE
UNDER CONTRACTS F33615-75C-5002,-78C-0516 AND -80C-05117

AND FOR THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION,
U.S. DEPARTMENT OF TRANSPORTATION, UNDER CONTRACTS
FH-11-7592, HS-053-2-485, HS-6-01300 AND HS-6-01410.

PROGRAM DOCUMENTATION: NHTSA REPORT NOS. DOT-HS-801-507
THROUGH 510 (FORMERLY CALSPAN REPORT NO. ZQ-5180-L-1),
AVAILABLE FROM NTIS (ACCESSION NOS. PB-241692,3,4 AND 5),
APPENDIXES A-J TO THE ABOVE (AVAILABLE FROM CALSPAN),
AND REPORT NOS. AMRL-TR-75-14 (NTIS NO. AD-A014 816),
AFAMRL-TR-80-14 (NTIS NO. AD-A088 029), AND
AFAMRL-TR-83-073 (NTIS NO. AD-B070 184).

PROGRAM ATB-IV, EXECUTED ON THE AAMRL/BB CONCURRENT
3250 COMPUTER, WRIGHT-PATTERSON AFB, OHIO

FEB. 4, 1988 IRSIN= 0 IRSOUT= 0 RSTIME = 0.0000 CARDS A

EXAMPLE 2: DYNAMIC JOINT TEST
SLIP JOINT / 600 KNOT WIND

UNITL = IN. UNITM = LB. UNITT = SEC. GRAVITY VECTOR = (0.0000, 0.0000, 386.0880) G = 386.0880

NDINT = 4 NSTEPS = 20 DT =0.002000 HO =0.000500 HMAX =0.001000 HMIN =0.000063

NPRT ARRAY

```
 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
 1  0 20  2  0  0  0  0  0  0  0  0  0  0  0  0  0 16  0  0  0  0  0  0  0  1  0  0  0  1  0  0  0  0  0  1
```

CARD B.1
CARDS B.2

SEGMENT			WEIGHT	PRINCIPAL MOMENTS OF INERTIA (LB.-SEC.**2- IN.)			SEGMENT CONTACT ELLIPSOID SEMIAXES (IN.)			CENTER (IN.)			PRINCIPAL AXES (DEG)		
I	SYM	PLOT	(LB.)	X	Y	Z	X	Y	Z	X	Y	Z	YAW	PITCH	ROLL
1	LARM	L	5.001	0.3331	0.3331	0.0214	1.871	1.871	10.269	0.000	0.000	0.000	0.00	0.00	0.00
2	UARM	U	5.542	0.1743	0.1743	0.0259	2.122	2.122	7.497	0.000	0.000	0.000	0.00	0.00	0.00

CARDS B.3

JOINT					LOCATION(IN.) - SEG(JNT)			LOCATION(IN.) - SEG(J+1)			PRIN. AXIS(DEG) - SEG(JNT)			PRIN. AXIS(DEG) - SEG(J+1)		
J	SYM	PLOT	JNT	PIN	X	Y	Z	X	Y	Z	YAW	PITCH	ROLL	YAW	PITCH	ROLL
1	ELBW	E	1	5	0.000	0.000	8.200	0.000	0.000	-5.420	0.00	0.00	0.00	0.00	-87.10	0.00

UNLOCK CONDITIONS FOR SLIP JOINTS

JOINT	TENSION (LB.)	COMPRESSION (LB.)
1	0.000	0.000

CARDS B.4

JOINT	FLEXURAL SPRING CHARACTERISTICS: SPRING COEF. (IN. LB./DEG**J) LINEAR (J=1)	QUADRATIC (J=2)	CUBIC (J=3)	ENERGY DISSIPATION COEF.	JOINT STOP (DEG)	TORSIONAL SPRING CHARACTERISTICS: SPRING COEF. (IN. LB./DEG**J) LINEAR (J=1)	QUADRATIC (J=2)	CUBIC (J=3)	ENERGY DISSIPATION COEF.	JOINT STOP (DEG)
1 ELBW	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

CARDS B.5

JOINT VISCOUS CHARACTERISTICS AND LOCK-UNLOCK CONDITIONS

JOINT	VISCOUS COEFFICIENT (IN. LB.SEC./DEG)	COULOMB FRICTION COEF. (IN. LB.)	FULL FRICTION ANGULAR VELOCITY (DEG/SEC.)	MAX TORQUE FOR A LOCKED JOINT (IN. LB.)	MIN TORQUE FOR UNLOCKED JOINT (IN. LB.)	MIN. ANG. VELOCITY FOR UNLOCKED JOINT (RAD/SEC.)	IMPULSE RESTITUTION COEFFICIENT
1 ELBW	0.000	0.00	30.00	0.00	0.00	0.00	0.000

SEGMENT INTEGRATION CONVERGENCE TEST INPUT

SEGMENT NO. SYM	ANGULAR VELOCITIES (RAD/SEC.) MAG. TEST	ABS. ERROR	REL. ERROR	LINEAR VELOCITIES (IN./SEC.) MAG. TEST	ABS. ERROR	REL. ERROR	ANGULAR ACCELERATIONS (RAD/SEC.**2) MAG. TEST	ABS. ERROR	REL. ERROR	LINEAR ACCELERATIONS (IN./SEC.**2) MAG. TEST	ABS. ERROR	REL. ERROR
1 LARM	0.000	0.000	0.0000	0.000	0.000	0.0000	0.010	0.010	0.0010	0.001	0.001	0.0010
2 UARM	0.000	0.000	0.0000	0.000	0.000	0.0000	0.010	0.010	0.0010	0.000	0.000	0.0000

VEHICLE DECELERATION INPUTS

CONSTANT WIND VELOCITY OF 800 KNOTS

YAW	PITCH	ROLL	VIPS	VTIME	XO(X)	XO(Y)	XO(Z)	NATAB	ATO	ADT	NSEQ
0.000	0.000	0.000	12161.000	0.000	0.000	0.000	0.000	-3	0.000000	2.300000	0

SPLINE FIT TABULAR INPUT

LTYPE = 2 LFIT = 1 NPTS = 3

	INITIAL LINEAR POSITION (IN.)			INITIAL ANGULAR POSITION (DEG)		
TIME(SEC.)= 0.0000	X= 0.000	Y= 0.000	Z= 0.000	X= 0.000	Y= 0.000	Z= 0.000

	LINEAR VELOCITY (IN./SEC.)			ANGULAR VELOCITY (DEG/SEC.)		
TIME(SEC.)	X	Y	Z	X	Y	Z
0.00000	0.000	0.000	12161.000	0.000	0.000	0.000
2.30000	0.000	0.000	12161.000	0.000	0.000	0.000
4.60000	0.000	0.000	12161.000	0.000	0.000	0.000

VEHICLE LINEAR TIME HISTORY CONSTANT WIND VELOCITY OF 800 KNOTS

TIME	LINEAR DECELERATIONS (G'S)			LINEAR VELOCITIES (IN./SEC.)			LINEAR DISPLACEMENTS (IN.)		
(MSEC)	X	Y	Z	X	Y	Z	X	Y	Z
0.000	0.000	0.000	0.000	0.000	0.000	12161.000	0.000	0.000	0.000
2300.000	0.000	0.000	0.000	0.000	0.000	12161.000	0.000	0.000	27970.300
4600.000	0.000	0.000	0.000	0.000	0.000	12161.000	0.000	0.000	55940.600

VEHICLE ANGULAR TIME HISTORY   CONSTANT WIND VELOCITY OF 600 KNOTS

TIME (MSEC)	ANGULAR ACCELERATIONS (DEG/SEC.**2) X	Y	Z	ANGULAR VELOCITIES (DEG/SEC.) X	Y	Z	ANGULAR DISPLACEMENTS (DEG) YAW	PITCH	ROLL
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2300.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4600.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

NPL	NBLT	NBAG	NELP	NQ	NSD	NHRNSS	NWINDF	NJNTF	NFORCE
1	0	0	0	0	0	0	1	0	0

CARD D.1

PLANE INPUTS

CARDS D.2

PLANE NO. 1 WIND PLANE

	X	Y	Z
POINT 1	10.0000	10.0000	5.0000
POINT 2	-10.0000	10.0000	5.0000
POINT 3	10.0000	-10.0000	5.0000

BODY SEGMENT SYMMETRY INPUT

CARD D.7

SEG NO. 1 2

NSYM(J) 0 0

WIND FORCE FUNCTION NO. 1 WIND FORCE NTI(1) = 1

SPEC. HEAT RATIO	SONIC VEL.	ABS. PRESS.	SEGMENT	REF. SEGMENT
1.4000	13404.0000	14.6960	1LARM	3VEH

SEGMENT WIND FORCES

SEGMENT-ELLIPSOID	SEGMENT-PLANE	WIND FORCE FUNCTION	DRAG COEFFICIENT FUNCTION	BLOCKING SEGMENTS-ELLIPSOID
-1 - 1 LARM	3 - 1 VEH -WIND PLANE	1 WIND FORCE	0	2- 2
-2 - 2 UARM	3 - 1 VEH -WIND PLANE	1 WIND FORCE	0	1- 1

CARD G.1

ZPLT(X)	ZPLT(Y)	ZPLT(Z)	I1	J1	I2	J2	I3	SPLT(1)	SPLT(2)	SPLT(3)
0.	0.	0.	0	0	0	0	1	10.00	6.00	1.00

INITIAL POSITIONS (INERTIAL REFERENCE)

CARDS G.2

SEGMENT	LINEAR POSITION (IN.)			LINEAR VELOCITY (IN./SEC.)		
NO. SEG	X	Y	Z	X	Y	Z
1 LARM	0.66000	0.00000	-18.98000	0.00000	0.00000	0.00000
2 UARM	0.18467	0.00000	-5.36830	0.00000	0.00000	0.00000

INITIAL ANGULAR ROTATION AND VELOCITY

CARDS G.3

SEGMENT	ANGULAR ROTATION (DEG)			ANGULAR VELOCITY (DEG/SEC.)			ITYPE			
NO. SEG	YAW	PITCH	ROLL	X	Y	Z				
1 LARM	0.00000	-2.00000	0.00000	0.00000	0.00000	0.00000	3	2	1	0
2 UARM	0.00000	-2.00000	0.00000	0.00000	0.00000	0.00000	3	2	1	0

TABULAR TIME HISTORY CONTROL PARAMETERS

TYPE	KSG	SELECTED SEGMENTS OR JOINTS		
H.1	0			
REF				
H.2	0			
REF				
H.3	3	1	2	2
REF		2	1	4
H.4	0			
REF				
H.5	0			
REF				
H.6	0			
REF				
H.7	1	1		
REF		0		
H.8	2	1	2	
REF		0	0	
H.9	1	1		
REF		1		

SEGMENT	(INERTIAL) ANGULAR ROTATION (DEG) YAW	PITCH	ROLL	(LOCAL) ANGULAR VELOCITY (RAD/SEC.) X	Y	Z	(LOCAL) ANGULAR ACCELERATION (RAD/SEC.**2) X	Y	Z
1 LARM	0.0000	-2.0000	0.0000	0.00000	0.00000	0.00000	0.000348	7.240952	-0.000315
2 UARM	0.0000	-2.0000	0.0000	0.00000	0.00000	0.00000	-0.000292	22.756331	0.000000
3 VEH	0.0000	0.0000	0.0000	0.00000	0.00000	0.00000	0.000000	0.000000	0.000000

SEGMENT	(INERTIAL) LINEAR POSITION (IN.) X	Y	Z	(INERTIAL) LINEAR VELOCITY (IN./SEC.) X	Y	Z	(INERTIAL) LINEAR ACCELERATIONS (G'S) X	Y	Z
1 LARM	0.6600	0.0000	-18.9800	0.00000	0.00000	0.00000	0.123940	0.000002	1.323803
2 UARM	0.1847	0.0000	-5.3683	0.00000	0.00000	0.00000	-0.131968	-0.000002	22.212334
3 VEH	0.0000	0.0000	0.0000	0.00000	0.00000	12161.00000	0.000000	0.000000	0.000000

SEGMENT	(INERTIAL) U1 ARRAY (IN./SEC.**2) EXTERNAL LINEAR ACCELERATIONS X	Y	Z	(LOCAL) U2 ARRAY (RAD/SEC.**2) EXTERNAL ANGULAR ACCELERATIONS X	Y	Z	KINETIC ENERGY (LB.- IN.) LINEAR	ANGULAR	TOTAL
1 LARM	0.0000D+00	0.0000D+00	0.5094D+03	0.57981D-03	-0.10774D+02	-0.31516D-03	0.00000D+00	0.00000D+00	0.00000D+00
2 UARM	0.0000D+00	0.0000D+00	0.8578D+04	-0.11465D-13	-0.38367D-14	-0.32149D-14	0.00000D+00	0.00000D+00	0.00000D+00
							TOTAL BODY KINETIC ENERGY		
							0.00000D+00	0.00000D+00	0.00000D+00

JOINT	IPIN	(INERTIAL) JOINT FORCES (LB.) X	Y	Z	(INERTIAL) JOINT TORQUES (IN. LB.) X	Y	Z	RELATIVE ANGULAR VELOCITY (RAD/SEC.)
1 ELBW	5	-0.731D+00	-0.941D-05	-0.255D-01	0.0000D+00	0.0000D+00	0.0000D+00	0.000

DINT CONV. TEST 1.000 LARM ANG ACC 3064. 0.4514E-02 0.1473E-05 0.1000E-03 0.1000E-03 0.1000E-05

TEST FAILED AT TIME = 0.001000 FOR H = 0.000500

MAIN3D FUNCTIONS FOR TIME= 40.000 MSEC

SEGMENT	(INERTIAL) ANGULAR ROTATION (DEG)			(LOCAL) ANGULAR VELOCITY (RAD/SEC.)			(LOCAL) ANGULAR ACCELERATION (RAD/SEC.**2)		
	YAW	PITCH	ROLL	X	Y	Z	X	Y	Z
1 LARM	0.0000	-4.6312	-0.0023	-0.00364	-2.40686	0.00000	-0.109497	-69.644370	0.000000
2 UARM	0.0000	1.9884	0.0050	0.00668	2.42783	-0.00004	0.012320	-49.752471	-0.000001
3 VEH	0.0000	0.0000	0.0000	0.00000	0.00000	0.00000	0.000000	0.000000	0.000000

SEGMENT	(INERTIAL) LINEAR POSITION (IN.)			(INERTIAL) LINEAR VELOCITY (IN./SEC.)			(INERTIAL) LINEAR ACCELERATIONS (G'S)		
	X	Y	Z	X	Y	Z	X	Y	Z
1 LARM	0.5275	0.0001	-13.8864	-7.63222	0.01244	255.94443	-0.611510	0.001260	17.016222
2 UARM	0.3257	-0.0001	-3.6569	8.12663	-0.01319	79.35888	0.864086	-0.001363	3.974519
3 VEH	0.0000	0.0000	486.4400	0.00000	0.00000	12161.00000	0.000000	0.000000	0.000000

SEGMENT	(INERTIAL) U1 ARRAY (IN./SEC.**2) EXTERNAL LINEAR ACCELERATIONS			(LOCAL) U2 ARRAY (RAD/SEC.**2) EXTERNAL ANGULAR ACCELERATIONS			KINETIC ENERGY (LB.- IN.)		
	X	Y	Z	X	Y	Z	LINEAR	ANGULAR	TOTAL
1 LARM	0.2552D-02	-0.6775D-08	0.6595D+04	0.59166D-07	-0.89447D-10	0.11024D-13	0.50106D+03	0.96483D+00	0.50202D+03
2 UARM	0.4609D-03	-0.1224D-08	0.1507D+04	0.24577D+00	0.98650D+02	-0.88356D-06	0.45674D+02	0.51370D+00	0.46188D+02
							TOTAL BODY KINETIC ENERGY		
							0.54673D+03	0.14785D+01	0.54821D+03

JOINT	IPIN	(INERTIAL) JOINT FORCES (LB.)			(INERTIAL) JOINT TORQUES (IN. LB.)			RELATIVE ANGULAR VELOCITY (RAD/SEC.)
		X	Y	Z	X	Y	Z	
1 ELBW	5	0.479D+01	-0.755D-07	0.388D+00	0.0000D+00	0.0000D+00	0.0000D+00	4.835

POSTPROCESSOR CONTROL PARAMETERS

	HIC & HSI POINT	CSI POINT
R.11	0	0

DATE: FEB. 4, 1988
RUN DESCRIPTION: EXAMPLE 2: DYNAMIC JOINT TEST
SLIP JOINT / 600 KNOT WIND
VEHICLE DECELERATION: CONSTANT WIND VELOCITY OF 600 KNOTS
CRASH VICTIM: 95TH PERCENTILE MALE

POINT REL. LINEAR DISPLACEMENT (IN.)

TIME	POINT (0.00, 0.00, 8.20) ON SEGMENT NO. 1 - LARM IN UARM REFERENCE				POINT (0.00, 0.00, -5.42) ON SEGMENT NO. 2 - UARM IN LARM REFERENCE				POINT (0.00, 0.00, 0.00) ON SEGMENT NO. 2 - UARM IN GRND REFERENCE			
(MSEC)	X	Y	Z	RES	X	Y	Z	RES	X	Y	Z	RES
0.000	0.000	0.000	-5.420	5.420	0.000	0.000	8.200	8.200	0.185	0.000	-5.368	5.371
0.500	0.000	0.000	-5.420	5.420	0.000	0.000	8.200	8.200	0.185	0.000	-5.368	5.371
0.750	0.000	0.000	-5.420	5.420	0.000	0.000	8.200	8.200	0.185	0.000	-5.367	5.370
1.000	0.000	0.000	-5.419	5.419	0.000	0.000	8.199	8.199	0.185	0.000	-5.366	5.370
1.500	0.000	0.000	-5.417	5.417	0.000	0.000	8.197	8.197	0.185	0.000	-5.365	5.368
2.000	0.000	0.000	-5.414	5.414	0.000	0.000	8.194	8.194	0.185	0.000	-5.362	5.366
3.000	0.000	0.000	-5.405	5.405	0.000	0.000	8.185	8.185	0.185	0.000	-5.356	5.359
4.000	0.000	0.000	-5.392	5.392	0.000	0.000	8.172	8.172	0.186	0.000	-5.347	5.350
5.000	0.000	0.000	-5.375	5.375	0.000	0.000	8.155	8.155	0.187	0.000	-5.336	5.339
6.000	0.000	0.000	-5.354	5.354	0.000	0.000	8.134	8.134	0.187	0.000	-5.322	5.325
7.000	0.000	0.000	-5.329	5.329	0.000	0.000	8.109	8.109	0.188	0.000	-5.306	5.309
8.000	-0.001	0.000	-5.299	5.299	0.000	0.000	8.079	8.079	0.190	0.000	-5.288	5.291
9.000	-0.001	0.000	-5.266	5.266	0.000	0.000	8.046	8.046	0.191	0.000	-5.268	5.271
10.000	-0.002	0.000	-5.228	5.228	0.000	0.000	8.008	8.008	0.192	0.000	-5.245	5.249
11.000	-0.002	0.000	-5.185	5.185	0.000	0.000	7.965	7.965	0.194	0.000	-5.221	5.224
12.000	-0.003	0.000	-5.138	5.138	0.000	0.000	7.918	7.918	0.196	0.000	-5.194	5.198
13.000	-0.005	0.000	-5.087	5.087	0.000	0.000	7.867	7.867	0.198	0.000	-5.166	5.170
14.000	-0.006	0.000	-5.032	5.032	0.000	0.000	7.812	7.812	0.200	0.000	-5.136	5.139
15.000	-0.008	0.000	-4.973	4.973	0.000	0.000	7.752	7.752	0.202	0.000	-5.103	5.107
16.000	-0.011	0.000	-4.909	4.909	0.000	0.000	7.688	7.688	0.204	0.000	-5.069	5.073
17.000	-0.013	0.000	-4.840	4.840	0.000	0.000	7.620	7.620	0.207	0.000	-5.032	5.036
18.000	-0.017	0.000	-4.768	4.768	0.000	0.000	7.548	7.548	0.210	0.000	-4.993	4.998
19.000	-0.021	0.000	-4.691	4.691	0.000	0.000	7.471	7.471	0.213	0.000	-4.953	4.957
20.000	-0.026	0.000	-4.610	4.610	0.000	0.000	7.389	7.389	0.216	0.000	-4.910	4.915
21.000	-0.031	0.000	-4.524	4.524	0.000	0.000	7.304	7.304	0.219	0.000	-4.865	4.870
22.000	-0.038	0.000	-4.435	4.435	0.000	0.000	7.214	7.214	0.223	0.000	-4.819	4.824
23.000	-0.045	0.000	-4.341	4.341	0.000	0.000	7.120	7.120	0.227	0.000	-4.770	4.775
24.000	-0.053	0.000	-4.242	4.243	0.000	0.000	7.021	7.021	0.231	0.000	-4.719	4.725
25.000	-0.063	0.000	-4.140	4.140	0.000	0.000	6.918	6.918	0.235	0.000	-4.667	4.673
26.000	-0.073	0.000	-4.033	4.034	0.000	0.000	6.811	6.811	0.239	0.000	-4.612	4.618
27.000	-0.085	0.000	-3.922	3.923	0.000	0.000	6.700	6.700	0.244	0.000	-4.555	4.562
28.000	-0.098	0.000	-3.807	3.808	0.000	0.000	6.584	6.584	0.248	0.000	-4.496	4.503
29.000	-0.113	0.000	-3.687	3.689	0.000	0.000	6.464	6.464	0.254	0.000	-4.436	4.443
30.000	-0.129	0.000	-3.563	3.565	0.000	0.000	6.339	6.339	0.259	0.000	-4.373	4.381
31.000	-0.146	0.000	-3.435	3.438	0.000	0.000	6.209	6.209	0.264	0.000	-4.309	4.317
32.000	-0.165	0.000	-3.302	3.306	0.000	0.000	6.075	6.075	0.270	0.000	-4.243	4.251
33.000	-0.186	0.000	-3.164	3.170	0.000	0.000	5.937	5.937	0.276	0.000	-4.175	4.184
34.000	-0.209	0.000	-3.022	3.030	0.000	0.000	5.793	5.793	0.282	0.000	-4.105	4.115
35.000	-0.234	0.000	-2.876	2.885	0.000	0.000	5.645	5.645	0.289	0.000	-4.035	4.045
36.000	-0.261	0.000	-2.724	2.737	0.000	0.000	5.492	5.492	0.296	0.000	-3.962	3.973
37.000	-0.289	0.000	-2.568	2.584	0.000	0.000	5.333	5.333	0.303	0.000	-3.888	3.900
38.000	-0.320	0.000	-2.407	2.428	0.000	0.000	5.170	5.170	0.310	0.000	-3.813	3.825
39.000	-0.353	0.000	-2.241	2.269	0.000	0.000	5.002	5.002	0.318	0.000	-3.735	3.749
40.000	-0.389	0.000	-2.071	2.107	0.000	0.000	4.829	4.829	0.326	0.000	-3.657	3.671

DATE: FEB. 4, 1986
RUN DESCRIPTION: EXAMPLE 2: DYNAMIC JOINT TEST
SLIP JOINT / 600 KNOT WIND
VEHICLE DECELERATION: CONSTANT WIND VELOCITY OF 600 KNOTS
CRASH VICTIM: 95TH PERCENTILE MALE

JOINT PARAMETERS

JOINT NO. 1 - ELBW

TIME	STATE	JOINT ANGLES (DEG)			TOTAL TORQUE (IN. LB.)		
(MSEC)	IPIN	FLEXURE	AZIMUTH	TORSION	SPRING	VISCOUS	RES.
0.000	5.	67.190	180.000	0.000	0.000	0.000	0.000
0.500	5.	67.189	180.000	0.000	0.000	0.000	0.000
0.750	5.	67.188	-180.000	0.000	0.000	0.000	0.000
1.000	5.	67.186	-180.000	0.000	0.000	0.000	0.000
1.500	5.	67.180	-180.000	0.000	0.000	0.000	0.000
2.000	5.	67.172	-180.000	0.000	0.000	0.000	0.000
3.000	5.	67.149	-180.000	0.000	0.000	0.000	0.000
4.000	5.	67.116	-180.000	0.000	0.000	0.000	0.000
5.000	5.	67.073	-180.000	0.000	0.000	0.000	0.000
6.000	5.	67.021	-180.000	0.000	0.000	0.000	0.000
7.000	5.	66.959	-180.000	0.000	0.000	0.000	0.000
8.000	5.	66.888	-180.000	0.000	0.000	0.000	0.000
9.000	5.	66.808	-180.000	0.000	0.000	0.000	0.000
10.000	5.	66.720	-180.000	0.000	0.000	0.000	0.000
11.000	5.	66.623	-180.000	0.000	0.000	0.000	0.000
12.000	5.	66.517	-180.000	0.000	0.000	0.000	0.000
13.000	5.	66.403	-180.000	0.000	0.000	0.000	0.000
14.000	5.	66.280	-180.000	0.000	0.000	0.000	0.000
15.000	5.	66.149	-180.000	0.000	0.000	0.000	0.000
16.000	5.	66.010	-180.000	0.000	0.000	0.000	0.000
17.000	5.	65.862	-180.000	0.000	0.000	0.000	0.000
18.000	5.	65.706	-180.000	0.000	0.000	0.000	0.000
19.000	5.	65.542	-180.000	0.000	0.000	0.000	0.000
20.000	5.	65.369	-180.000	0.000	0.000	0.000	0.000
21.000	5.	65.189	-180.000	0.000	0.000	0.000	0.000
22.000	5.	65.001	-180.000	0.000	0.000	0.000	0.000
23.000	5.	64.805	-180.000	0.000	0.000	0.000	0.000
24.000	5.	64.601	-180.000	0.000	0.000	0.000	0.000
25.000	5.	64.390	-180.000	0.000	0.000	0.000	0.000
26.000	5.	64.171	-180.000	0.000	0.000	0.000	0.000
27.000	5.	63.945	-180.000	0.000	0.000	0.000	0.000
28.000	5.	63.713	-180.000	-0.001	0.000	0.000	0.000
29.000	5.	63.474	-179.999	-0.001	0.000	0.000	0.000
30.000	5.	63.230	-179.999	-0.001	0.000	0.000	0.000
31.000	5.	62.980	-179.999	-0.002	0.000	0.000	0.000
32.000	5.	62.724	-179.999	-0.002	0.000	0.000	0.000
33.000	5.	62.464	-179.998	-0.002	0.000	0.000	0.000
34.000	5.	62.200	-179.998	-0.003	0.000	0.000	0.000
35.000	5.	61.934	-179.998	-0.003	0.000	0.000	0.000
36.000	5.	61.666	-179.998	-0.003	0.000	0.000	0.000
37.000	5.	61.395	-179.997	-0.004	0.000	0.000	0.000
38.000	5.	61.122	-179.997	-0.004	0.000	0.000	0.000
39.000	5.	60.847	-179.997	-0.004	0.000	0.000	0.000
40.000	5.	60.570	-179.996	-0.005	0.000	0.000	0.000

DATE: FEB. 4, 1988
RUN DESCRIPTION: EXAMPLE 2: DYNAMIC JOINT TEST
SLIP JOINT / 600 KNOT WIND
VEHICLE DECELERATION: CONSTANT WIND VELOCITY OF 600 KNOTS
CRASH VICTIM: 95TH PERCENTILE MALE

SEGMENT WIND FORCE (LB.)

TIME (MSEC)	SEGMENT NO. 1 - LARM IN GRND REFERENCE				SEGMENT NO. 2 - UARM IN GRND REFERENCE			
	X	Y	Z	RES	X	Y	Z	RES
0.000	0.000	0.000	1.885	1.885	0.000	0.000	117.584	117.584
0.500	0.000	0.000	92.336	92.336	0.000	0.000	28.783	28.783
0.750	0.000	0.000	92.311	92.311	0.000	0.000	28.775	28.775
1.000	0.000	0.000	92.268	92.288	0.000	0.000	28.768	28.768
1.500	0.000	0.000	92.242	92.242	0.000	0.000	28.752	28.752
2.000	0.000	0.000	92.198	92.198	0.000	0.000	28.735	28.735
3.000	0.000	0.000	92.112	92.112	0.000	0.000	28.702	28.702
4.000	0.000	0.000	92.032	92.032	0.000	0.000	28.667	28.667
5.000	0.000	0.000	91.958	91.958	0.000	0.000	28.632	28.632
6.000	0.000	0.000	91.888	91.888	0.000	0.000	28.595	28.595
7.000	0.000	0.000	91.825	91.825	0.000	0.000	23.798	23.798
8.000	0.000	0.000	91.766	91.766	0.000	0.000	23.765	23.765
9.000	0.000	0.000	91.713	91.713	0.000	0.000	23.733	23.733
10.000	0.000	0.000	91.666	91.666	0.000	0.000	23.699	23.699
11.000	0.000	0.000	91.624	91.624	0.000	0.000	23.666	23.666
12.000	0.000	0.000	91.589	91.589	0.000	0.000	23.632	23.632
13.000	0.000	0.000	91.560	91.560	0.000	0.000	23.597	23.597
14.000	0.000	0.000	91.538	91.538	0.000	0.000	23.563	23.563
15.000	0.000	0.000	91.523	91.523	0.000	0.000	23.529	23.529
16.000	0.000	0.000	91.516	91.516	0.000	0.000	23.494	23.494
17.000	0.000	0.000	91.516	91.516	0.000	0.000	23.460	23.460
18.000	0.000	0.000	91.524	91.524	0.000	0.000	23.427	23.427
19.000	0.000	0.000	91.541	91.541	0.000	0.000	23.394	23.394
20.000	0.000	0.000	91.567	91.567	0.000	0.000	23.361	23.361
21.000	0.000	0.000	91.602	91.602	0.000	0.000	23.330	23.330
22.000	0.000	0.000	91.648	91.648	0.000	0.000	23.299	23.299
23.000	0.000	0.000	91.704	91.704	0.000	0.000	23.269	23.269
24.000	0.000	0.000	91.772	91.772	0.000	0.000	23.240	23.240
25.000	0.000	0.000	91.852	91.852	0.000	0.000	23.213	23.213
26.000	0.000	0.000	91.944	91.944	0.000	0.000	23.187	23.187
27.000	0.000	0.000	92.050	92.050	0.000	0.000	23.162	23.162
28.000	0.000	0.000	92.169	92.169	0.000	0.000	20.825	20.825
29.000	0.000	0.000	92.303	92.303	0.000	0.000	20.806	20.806
30.000	0.000	0.000	92.451	92.451	0.000	0.000	20.789	20.789
31.000	0.000	0.000	92.615	92.615	0.000	0.000	20.773	20.773
32.000	0.000	0.000	92.796	92.796	0.000	0.000	20.758	20.758
33.000	0.000	0.000	92.994	92.994	0.000	0.000	16.136	16.136
34.000	0.000	0.000	93.209	93.209	0.000	0.000	16.127	16.127
35.000	0.000	0.000	93.442	93.442	0.000	0.000	16.119	16.119
36.000	0.000	0.000	93.693	93.693	0.000	0.000	16.113	16.113
37.000	0.000	0.000	93.963	93.963	0.000	0.000	16.108	16.108
38.000	0.000	0.000	94.254	94.254	0.000	0.000	16.103	16.103
39.000	0.000	0.000	94.566	94.566	0.000	0.000	16.100	16.100
40.000	0.000	0.000	94.900	94.900	0.000	0.000	16.097	16.097

DATE: FEB. 4, 1988
RUN DESCRIPTION: EXAMPLE 2: DYNAMIC JOINT TEST
SLIP JOINT / 600 KNOT WIND
VEHICLE DECELERATION: CONSTANT WIND VELOCITY OF 600 KNOTS
CRASH VICTIM: 95TH PERCENTILE MALE

ELBW JOINT FORCES & TORQUES ON UARM IN LARM REFERENCE

TIME	JOINT FORCE (LB. 10**2)			JOINT TORQUE (IN.- LB. 10**2)		
(MSEC)	X	Y	Z	X	Y	Z
0.000	-0.007	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
0.500	0.022	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
0.750	0.022	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
1.000	0.022	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
1.500	0.022	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
2.000	0.023	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
3.000	0.023	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
4.000	0.023	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
5.000	0.023	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
6.000	0.023	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
7.000	0.022	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
8.000	0.022	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
9.000	0.022	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
10.000	0.022	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
11.000	0.023	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
12.000	0.023	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
13.000	0.023	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
14.000	0.024	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
15.000	0.024	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
16.000	0.025	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
17.000	0.025	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
18.000	0.026	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
19.000	0.027	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
20.000	0.027	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
21.000	0.028	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
22.000	0.029	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
23.000	0.030	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
24.000	0.030	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
25.000	0.031	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
26.000	0.032	-0.002	0.000	0.000D+00	0.000D+00	0.000D+00
27.000	0.034	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
28.000	0.032	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
29.000	0.034	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
30.000	0.035	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
31.000	0.036	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
32.000	0.038	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
33.000	0.034	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
34.000	0.036	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
35.000	0.038	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
36.000	0.040	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
37.000	0.041	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
38.000	0.044	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
39.000	0.046	0.000	0.000	0.000D+00	0.000D+00	0.000D+00
40.000	0.048	0.000	0.000	0.000D+00	0.000D+00	0.000D+00

ELAPSED CPU TIME = 30.91 SECONDS

SUB	CALLS	TIME	%
MAIN3D	1	47	1.52
INPUT	1	44	1.42
CHAIN	192	37	1.20
EJOINT	192	3	0.10
DINT	21	143	4.63
PDAUX	234	123	3.98
DAUX	191	86	2.78
SETUP1	191	46	1.49
CONTCT	191	22	0.71
WINDY	382	2109	68.23
VISPR	191	72	2.33
SETUP2	191	6	0.19
DAUX11	191	31	1.00
DAUX12	191	1	0.03
DAUX22	191	9	0.29
FSMSOL	191	22	0.71
OUTPUT	44	79	2.56
UPDATE	43	3	0.10
DZP	190	42	1.36
POSTPR	1	166	5.37
TOTAL		3091	100.00

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4. Fleck, J.T., Butler, F.E., and DeLeys, N.J., "Validation of the Crash Victim Simulator," Calspan Report Nos. ZS-5881-V-1 through 4, DOT-HS-806-279 through 282, 1982, Vols. 1-4 (NTIS No. PC E99, PB86-212420).

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6. Leetch, B.D., Bowman, W.L., Articulated Total Body (ATB) VIEW Program Software Report," Report nos. AMRL-TR-81-111, Vols 1 & 2, June 1983 (NTIS Nos. AD-B075 161 & 162).